Asian Journal of Instruction
Asya Öğretim Dergisi

Cilt: 12 • Sayı: 2 • Yıl: 2024

dergipark.gov.tr/aji
ISSN:2148-2659

ASIAN JOURNAL OF INSTRUCTION

(ASYA ÖĞRETİM DERGİSİ)

ISSN: 2148-2659

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Asian Journal of Instruction
Asya Öğretim Dergisi

2024, 12(2), 01-20

dergipark.gov.tr/aji
ISSN:2148-2659

Recieved: 07/06/2024 Accepted: 28/10/2024 Published: 31/12/2024

Classroom Teachers' Perspectives on New Approaches to Teaching Mathematics*

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Doğan, A., & Kütükçü, S. (2024). Classroom teachers' perspectives on new approaches to teaching mathematics. *Asian Journal of Instruction, 12*(2), 1-20. Doi: 10.47215/aji.1497320

Abstract

Developments with in mathematics education, alternative and innovative learning approaches have begun to be used, creating appropriate learning environments for students to learn and do mathematics. This study aimed to explore the views of classroom teachers on new approaches to mathematics teaching. A qualitative case study design was used.The study group consisted of 35 classroom teachers. A semi-structured interview form was used to collect data. The data obtained were analyzed by content analysis. It was found that the classroom teachers most frequently used technology-enhanced mathematics teaching and problem-based mathematics teaching, while flipped learning and project-based mathematics teaching were used the least among the new approaches in mathematics teaching. It was concluded that although classroom teachers reported using new approaches to teaching mathematics in all subjects, they used them most in the subject of fractions, and the reasons for using the preferred new approaches were that they provided continuous learning and facilitated learning. According to the classroom teachers, the main difficulty in implementing new approaches is time-consuming. In addition, it was found that classroom teachers stated that the advantages of new approaches in the teaching process are that they provide continuous learning and make lessons interesting and fun and that the disadvantages are that they are time-consuming. In line with the results obtained, it is recommended that classroom teachers make more use of new approaches in mathematics teaching and that seminars be organized to support this.

Keywords: Classroom teacher, mathematics teaching, new approaches, primary school mathematics

1. Introduction

Mathematics education aims to provide individuals with the mathematical concepts and skills they need in everyday life and to develop 21st-century individuals who can use these skills in everyday life. Developments in information and technology have led to changes and innovations in education. These changes and innovations lead to new approaches and learning models that are used instead of traditional methods in the teaching process (Gökcen & Kadıoğlu, 2020). In traditional methods of teaching mathematics, which do not meet the differentiated needs of the age group, operational and computational skills are at the forefront, while skills such as reasoning,

* This study was presented as an oral presentation at the 3rd BİLSEL International Truva Scientific Researches and Innovation Congress held on 25-26 May, 2024 in Çanakkale/Turkey.

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problem-solving, and prediction have become more important through innovative approaches (Altun, 2016). Particularly in mathematics, where the foundations are laid in primary school, classroom teachers' preference for new approaches that facilitate acquisition learning where students are active, rather than traditional approaches, ensures that students have positive attitudes towards learning mathematics. Classroom teachers should enrich the learning environment by using different methods and approaches in the mathematics teaching process (Tol & Çenberci, 2019).

There are many new approaches and methods that a classroom teacher can use to teach mathematics. Classroom teachers can make a meaningful difference for students and make mathematics more enjoyable by using effective new approaches that are most appropriate for the students and the subject in the mathematics teaching process (Atay, 2023). At this point, classroom teachers should be innovative teachers who follow current approaches and apply these new approaches in their teaching, in short, keeping up with the times. From this point of view, the study aimed to obtain the opinions of classroom teachers about new approaches to teaching mathematics. For these reasons, new approaches that can be used in the teaching of mathematics, according to the purpose of the study, were defined as follows. For these reasons, the following new approaches to mathematics education were identified for the study: Realistic mathematics education, technology-enhanced mathematics education, flipped learning, problem-based mathematics education, cooperative learning, STEM education, arts-based mathematics education, creative drama, project-based mathematics education, professional development model for teachers, learning roadmap-based teaching, inquiry-based mathematics education, differentiated instruction, justification, inclusive education.

Realistic mathematics education is a theory of mathematics education developed by the Freudenthal Institute in the Netherlands in the early 1970^{s} (Çilingir, 2015). Realistic mathematics education is based on Freudenthal's view that mathematics must be related to reality and that mathematics is a human activity (Demirdöğen & Kaçan, 2010). In this approach, the human need to do mathematics is the basis of mathematics education, and mathematics education begins with real-life problem examples. In the realistic approach to mathematics education, the learning process is expressed as the acquisition of formal knowledge as a result of students creating their solutions and generating new models when they encounter contextual problems selected from real life based on their informal knowledge gained from their own life experiences. The process starts with real-life problems and at the end of the process, students arrive at mathematical concepts and theories. This structure is known as mathematisation (Filiz, 2023).

Technology-supported mathematics teaching is the use of instructional technologies to enrich and improve the quality of education during the teaching activities of the mathematics course (Öztürk, 2019). Flipped learning is the process by which students acquire the information to be acquired through videos and similar media previously provided at home, and discuss and evaluate the information acquired in the group to make the time spent in the classroom environment more meaningful and efficient (Karamuk Eskiköy & Liman Kaban, 2023). The flipped learning approach is an approach based on students doing their homework in the classroom and watching the lessons at home (Topbaş Tat, 2023).

Problem-based learning is a learning method that enables critical thinking, presenting original ideas, reasoning, deducing, solving problems, and establishing mathematical relationships by organizing mathematical structures around problem-solving activities (Cantürk Günhan & Başer, 2008). Cooperative learning is a learning approach in which students form small mixed learning groups to achieve a common goal in the classroom environment, helping each other to learn the academic subject and rewarding the group's success in different ways. Cooperative learning aims to maximize learning by students working together with team spirit (Gümüş & Buluç, 2007).

STEM education is an educational approach that includes science, technology, engineering, and mathematics disciplines and aims to produce original solutions to real-life problems by using them in an integrated way and is used at all levels of education (Ültay, Üstüner, Sünbül & Taştan, 2023). In the learning and teaching environment of STEM education, students try to use design skills and create innovative products through applied activities to produce solutions to the problems that arise (Dokumacı Sütçü, Bilgiç Uçak & Toprak, 2023; Şahin, 2021). Arts-based education is mostly considered a process in which the arts are considered as a tool to improve learning in different fields or as an integrated process to improve learning in both the arts and other fields (Kuş, 2023). On this basis, visual arts and mathematics have been linked. Visual arts can be used in mathematics education to encourage and motivate students to learn mathematics (Kuş, 2019).

The lesson study professional development model is a professional development approach adapted from Japan that enables a small group of teachers to plan, observe, analyze, and improve their daily teaching and provides professional development for teachers and teacher candidates. Lesson study allows groups of teachers to work together to research, develop, and implement lessons that have a direct impact on students and improve the quality of teaching (Gökkurt Özdemir, 2023). Teaching based on a learning roadmap is the result of experimental investigations that focus on students' learning and allow them to understand the paths they follow in this process, to construct students' understanding of basic scientific concepts, explanations, and scientific practices with appropriate teaching, and how the ability to use them develops (Yıldırım Bozcuoğlu, 2020).

Inquiry is an approach that requires students to be active in the learning process by investigating information through the process of reasoning, exploring critical and logical thinking to improve understanding of content and solve a problem. Inquiry used in mathematics education includes various mathematical thinking processes such as problem-solving, metacognition, reasoning and making connections, representing, communicating, modeling, discussing, and proving (Şahin, 2019). Differentiated instruction is a new student-centered teaching approach that provides an appropriate educational environment and active participation for all students who have different characteristics in terms of their readiness, interests, abilities, learning styles, needs, and academic achievements (Çam & Acat, 2023). Teachers can create a classroom environment that can meet the different needs of students by differentiating the content, process, product, or learning environment element (Gregory & Chapman, 2022).

Justification is a fundamental aspect of proving the validity of mathematical statements and arguments. Justification involves providing logical reasoning and evidence to support the steps taken in a mathematical proof. This process is necessary to ensure the accuracy and validity of mathematical results. Inclusive education is an approach to education based on providing equal opportunities and fair conditions for all students. Inclusive education is an approach to education that provides appropriate support to meet the diverse learning needs of all individuals in the same learning environment. This approach aims to enable individuals with different abilities, backgrounds, cultures, and characteristics to participate in the education and training process in the best possible way and to support them to benefit from educational services (Oğlakçı & Amaç, 2024).

Köşece and Taşkaya (2015), in their study which aimed to find out the opinions of classroom teachers about the teaching methods they use in mathematics class, found that classroom teachers mostly used problem-solving, lecture, and question-answer methods in mathematics class; computer-assisted instruction could not be used for various reasons, although some teachers wanted to use it; and the methods that were not used in class could not be used due to the limited

physical facilities of the school. As a result of the study, it was suggested that classroom teachers should be trained in teaching methods for mathematics lessons.

In the study conducted by Soylu (2009), which aimed to determine the level of pre-service primary school teacher's ability to use teaching methods and techniques in mathematics education, it was concluded that most of the pre-service teachers felt competent or partially competent in methods and techniques such as lecture, definitions, rules, and question-answer, while they felt inadequate in methods and techniques such as constructivist, invention, cooperative, demonstration, games, case study, problem posing and solving.

In a study conducted by Karasu Avcı and Ketenoğlu Kayabaşı (2019), classroom teachers generally considered themselves competent in the use of methods and techniques. Topan (2013) conducted a meta-analysis study on the effectiveness of student-centered methods in mathematics education on academic achievement and attitudes towards the course and concluded that student-centered methods in mathematics education are positively effective on both academic achievement and attitudes towards the course compared to traditional methods and that this level of effectiveness does not differ according to teaching level, application period, and learning area. As a result of the literature review, the importance of classroom teachers' ability to use approaches, methods, and techniques in mathematics education is understood. To effectively use new approaches in mathematics teaching, classroom teachers should have the necessary knowledge about new approaches.

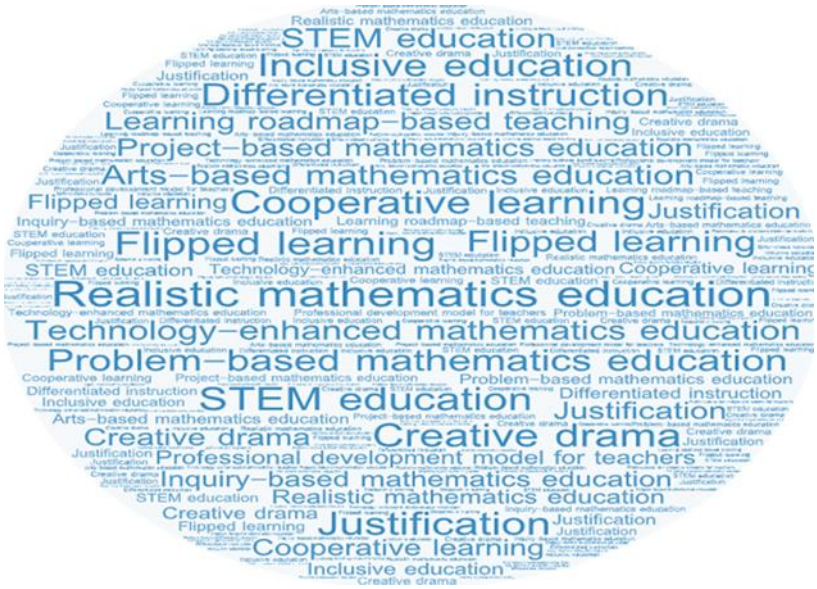

Figure 1. *New Approaches in Mathematics Teaching Discussed in The Study*

The problem statement of this study is that the level of knowledge of classroom teachers about new approaches to teaching mathematics is not known. It is important to reveal the opinions of classroom teachers to reveal their knowledge about this subject. It is important to reveal the opinions of classroom teachers about new approaches to mathematics teaching and to make suggestions in this direction to ensure that mathematics learning is permanent and meaningful in primary schools where students start their educational life (Yorulmaz & Çokçalışkan, 2017). It can be seen that there are some studies in the literature about the approaches, methods, and techniques used in mathematics education, but there is no study in the literature that takes the opinions of classroom teachers about new approaches in mathematics education. For this reason,

there was a need for a study that sought the opinions of classroom teachers on new approaches to teaching mathematics.

Against this background, the study aimed to find out the opinions of classroom teachers about new approaches to teaching mathematics. By the aim of the study, the following questions were put to the participating classroom teachers:

1. Which of the new approaches do you use? Choose 3 approaches that you think you use most.
2. How do the new approaches you use to teach mathematics differ from traditional approaches?
3. How do the new approaches you use to teach mathematics affect students' participation in class and their learning outcomes?
4. How often do you use your preferred new approaches to teaching mathematics and how do you integrate them into the teaching process?
5. In which subjects do you use your preferred new approaches to teaching mathematics?
6. What kind of differentiation techniques do you use with your preferred new approaches to teaching mathematics?
7. What are your reasons for using the new approaches you use in mathematics teaching?
8. What are the difficulties you have encountered in implementing the new approaches you use in mathematics teaching?
9. What are the new approaches that you know about but do not use in mathematics teaching?
10. What do you think about the advantages and disadvantages of the new approaches you use in mathematics teaching?

2. Method

2.1. Research Model

The study was conducted using the case study model, a qualitative research design. Case studies are a research design used in many fields, particularly in evaluation processes, in which the researcher analyses a situation, often a program, an event, an action, a process, or one or more individuals, in-depth (Creswell, 2017). In research, case studies are used to a) identify and examine the details of an event, b) develop possible explanations for an event, and c) evaluate an event (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz & Demirel, 2022). In this study, this model was used to explore in depth the views of classroom teachers on new approaches to teaching mathematics.

2.2. Study Group

The study group of the research consists of 35 classroom teachers. Purposive sampling was used to select the study group. Purposive sampling enables in-depth research by selecting information-rich situations according to the purpose of the study (Büyüköztürk et al., 20-22). In this study, according to the purpose of the research, classroom teachers were selected through purposive sampling by considering that they had different years of experience, had undergraduate and graduate education, and worked in villages, towns, and city centers. It is assumed that the seniority of the teachers, the place where they work, and the training they have received will influence the teaching methods they use. The demographic characteristics of the classroom teachers in the study group are shown in Table 1.

Table 1

Demographic Characteristics of Participants

Variables		Frequency (f)
Gender	Female	19
	Male	16
Age	22-30	17
	30-35	2
	35-40	9
	40-45	5
	50-55	1
	55+	1
Educational Level	Associate's Degree	1
	Licence	29
	Master's Degree	5
Years of Experience	0-5	16
	5-10	3
	10-15	5
	15-20	7
	20-25	3
	25+	1

An analysis of Table 1 shows that nineteen of the participating classroom teachers were female and sixteen were male. In terms of age, there are seventeen teachers aged 22-30, two teachers aged 30-35, nine teachers aged 35-40, five teachers aged 40-45, one teacher aged 50-55 and one teacher aged 55 and over. One of the classroom teachers who participated in the study has an associate degree, twenty-nine have a bachelor's degree, and five have a master's degree. When analyzing the seniority of the classroom teachers, there are sixteen teachers with 0-5 years, three teachers with 5-10 years, five teachers with 10-15 years, seven teachers with 15-20 years, three teachers with 20-25 years and one teacher with 25 years or more.

2.3. Data Collection Instruments

The interview can be defined as the collection of data from the relevant people within the framework of the questions to be answered in the research (Büyüköztürk et al., 2022). In this study, a semi-structured interview form was used to collect data. While preparing the semi-structured interview form, a literature review on the topic was conducted and a pool of questions on new approaches in mathematics education was created. The forms with the questions used in the study were filled in by the participants and the data were also enriched through interviews. The form consists of three parts. The first part contains general information about the research and whether the participants volunteered to take part in the research, the second part contains questions about the demographic information of the participants, and the third part contains questions about the research topic. The interview form has 10 questions. After the interview form was prepared, the opinion of a faculty member in the field of classroom education was sought to determine its suitability for the study. By the opinions received, necessary corrections were made to the semi-structured interview form and it was made ready for use. The questions for the semi-structured interview form were sent to the participants using Google Form, a web-based application. The interview was then conducted with the participants using the Zoom program and lasted 10-15 minutes.

2.4. Data Collection

After finalizing the data collection tool to be used in the research, the interview form was sent to each classroom teacher via the WhatsApp messaging application by creating a Google Forms link to request answers to the questions in the semi-structured interview form. During the data collection process, interviews were conducted with the classroom teachers who volunteered to complete the interview form. After the classroom teachers completed the demographic information sections of the semi-structured interview forms sent to them, data were collected by conducting in-depth interviews with those who agreed to be interviewed via the Zoom program.

2.5. Data Analysis

The content analysis method was used to analyze the data obtained from the research. Content analysis is based on bringing together similar data within the framework of certain concepts and themes, and organizing and interpreting them in a way that readers can understand (Yıldırım & Şimşek, 2018). Content analysis is a technique in which inferences are made to identify certain features of a message objectively and systematically (Büyüköztürk et al., 2022). The reason why the content analysis was preferred in the study is that the responses of the participating classroom teachers should be analyzed in depth and systematically (Devecioğlu, Zorluoğlu & Doğru, 2022).

In the data analysis, the interview forms were named (T1, T2, T3, ...T35). The data obtained from the forms were carefully read and analyzed. Subcategories were formed by bringing together the related codes from the collected data. An attempt was made to create categories from these subcategories. As a result of the content analysis, categories, subcategories, and codes were formed from the opinions of the participating classroom teachers. To ensure comprehensibility, the opinions of the classroom teachers were transformed into tables and presented with their frequencies in the findings section. After interpreting the tables, direct quotations of the participants' opinions were given.

2.6. Validity and Reliability

To ensure the validity and reliability of the study, the credibility, transferability, consistency, and confirmability strategies specified by Lincoln and Guba (1985) were used. The credibility of the study was increased by providing detailed information about the characteristics of the participants, obtaining an expert's opinion while preparing the research questions, and making the necessary arrangements according to the expert's opinion. To ensure transferability, the demographic characteristics of the classroom teachers and the findings from the data are presented in detail with their frequencies. Direct quotations were made from the classroom teachers' responses. To ensure the consistency of the research findings, the researchers explained in detail the method of the study, the process of preparing the data collection instruments and data collection, and how the data were analyzed. The raw data, coding, semi-structured interview forms, and analysis processes obtained by the researchers were retained to ensure verifiability.

To ensure consistency of coding during data analysis in the study, the researchers coded separately and were unaware of each other. Agreement between the two coders was calculated using Miles and Huberman's (1994, p. 64) formula (reliability = agreement/agreement + disagreement x 100), and the agreement rate between the coders was calculated as .84. In cases where the value calculated using the Miles-Huberman reliability formula is higher than .70, it can be said that the coding is reliable (Akay & Ültanır, 2010, p. 80). In cases where there was a different coding idea, the reason was analyzed and the code was decided by discussing it together (Silverman, 2005). New codes and themes were easily integrated into the scheme, inappropriate codes were removed

and necessary adjustments were made. The final stage was to organize the data with figures and to quote from the teachers' opinions during the presentation.

2.7. Ethics Committee Approval

In this study, all the rules stated in the Directive of Scientific Research and Publication Ethics of Higher Education Institutions were followed. Approval was obtained from Kahramanmaraş Sütçü İmam University Social and Human Sciences Ethics Committee on 17.07.2024, dated and numbered E-72321963-050.04-327794.

3. Results

This part of the study presents the results of the analysis of the answers given by the participants to the questions in the semi-structured interview form.

The answers to the first question of the research "Which of the new approaches (which ones) do you use in mathematics teaching? Choose the 3 approaches that you think you use most." are shown in Table 2.

Table 2

The First Three Approaches Preferred by Classroom Teachers When Teaching Mathematics

Category	Codes	Frequency (f)
New Approaches to Mathematics Education	Technology-supported mathematics education	28
	Problem-based mathematics teaching	23
	Cooperative learning	12
	Realistic mathematics teaching	12
	Creative drama	9
	Inquiry-based mathematics education	9
	STEM education	3
	Flipped learning	2
	Project-based mathematics education	2

An analysis of Table 2 shows that the new approaches to teaching mathematics used by the classroom teachers who participated in the study are technology-enhanced mathematics teaching (28), problem-based mathematics teaching (23), cooperative learning (12), realistic mathematics teaching (12), creative drama (9), inquiry-based mathematics teaching (9), STEM education (3), flipped learning (2) and project-based mathematics teaching (2). According to the table, classroom teachers most preferred 'technology enhanced mathematics teaching' and 'problem-based mathematics teaching' approaches to teaching mathematics. According to Table 2, classroom teachers reported having used 'flipped learning' and 'project-based mathematics teaching' at least once in mathematics class. In addition to the approaches mentioned in the table in the first question, arts-based mathematics teaching, the professional development model of lesson study, teaching based on a learning roadmap, differentiated teaching, justification, and inclusive education approaches were also presented to classroom teachers as options. However, it was observed that most of the participating classroom teachers did not prefer these approaches to mathematics teaching. Only the 'professional development model' and the 'justification' approaches were marked by one class teacher.

The responses to the second research question, "How do the new approaches you use to teach mathematics differ from traditional approaches?" are presented in Table 3.

Table 3

The Difference of New Approaches Used in Teaching Mathematics from Traditional Approaches

Category	Category	Codes	Frequency (f)
Features Distinguishing New Approaches from Traditional Approaches	Student-Centred	Effective participation in the classroom	17
		Putting the student at the centre	9
	Teaching Processes	Continuous learning	7
		Facilitating understanding	7
		Enabling discovery	6
		Developing the ability to question	4
		Embodiment	2
	Motivation	Being interesting	9
		Use in daily life	7
		Enjoying the lesson	2

Looking at Table 3, we can see that the category of characteristics that distinguish new approaches from traditional approaches consists of three subcategories: student-centered, teaching processes, and motivation. In the student-centered subcategory, the responses were effective in-class participation (17) and student-centered (9). In the subcategory of teaching processes, the responses were continuous learning (7), facilitating understanding (7), enabling discovery (6), developing questioning skills (4), and concretization (2). In the subcategory of motivation, the responses were interesting (9), applicable to everyday life (7), and enjoyed the lesson (2). It was found that the classroom teachers who participated in the research stated that the difference between the new approaches they used in teaching mathematics and the traditional approaches was mostly effective in terms of student's participation in the lesson. Below is the interview transcript of the teacher-coded T3.

R (Researcher): *How do the new approaches you use to teach mathematics differ from the traditional approaches?*

T3: *The difference between the new approaches I use in teaching mathematics and the traditional approaches is mainly that I teach by involving the students more actively in the lesson. Apart from that, the new approaches we use are more fun for the students. As an example, I can give the mathematics lessons I teach with the support of technology.*

The answers to the third question of the research "What are the effects of the new approaches you use in teaching mathematics on students' participation in the lesson and on their learning outcomes?" are presented in Table 4.

Table 4

Effects of New Approaches ot Mathematics Teaching on Teaching Processes

Category	Subcategory	Codes	Frequency (f)
Contribution to Teaching Processes	Impact on Learning the Gains	Facilitate learning	19
		Make learning fun	13
		Use in daily life	5
		Process-oriented learning	5
		Becoming successful	2
		Effects on class participation	2
	Providing Ongoing Learning	Increased class participation	16
		Increased interest and motivation	14
		Increased confidence in participation in class	2

An analysis of Table 4 shows that the category of contribution to learning processes consists of two subcategories: effects on learning outcomes and effects on participation in learning. In the subcategory of effects on learning outcomes, it can be seen that the answers given were providing lasting learning (19), facilitating learning (13), enjoying learning (5), being able to use in everyday life (5), process-oriented learning (2) and being successful (2). In the sub-category of effects on participation in class, it can be seen that the responses were increased participation in class (16), increased interest and motivation (14), and increased confidence in participating in class (2). Below is the interview transcript of the teacher-coded T23.

R: *What are the effects of the new approaches you use in mathematics teaching on pupils' participation in class?*

T23: *Because the new approaches I use appeal to the students, their motivation towards the lesson increases. This allows them to actively participate in the lesson and learn the results.*

The answers to the question "How often do you use the new approaches you prefer in mathematics teaching and how do you integrate them into the teaching process?" are given in Table 5.

Table 5

Integration of New Approaches to Mathematics Teaching into The Teaching Process and Frequency of Use

Category	Subcategory	Codes	Frequency (f)
Integration Types and Usage Frequencies	How to Integrate	Those who do not provide information about the way of integration	13
		Integrating into the narrative	9
		Reinforcement and evaluation process	8
		Content and materials in the approach	5
		Using real-life problem situations	2
		Using ntegrating with smart board	2
	Frequency of Use	Always	14
		According to eligibility for earnings	7
		Very stylish	6
		1-2 times a week	4
		3 times a week	3

An analysis of Table 5 shows that the category of integration methods and frequency of use consists of two subcategories: integration methods and frequency of use. In the subcategory of integration methods, it can be seen that the answers of those who did not give any information about the integration methods were as follows: integration into the subject expression (13), integration into the reinforcement and evaluation process (9), integration into the approach of activities, content, and materials (5), use of real-life problem situations (2), use through integration with the Smart Board (2). In the subcategory of frequency of use, the participants gave the following answers: always (14), depending on the appropriateness of the result (7), very often (6), 1-2 times a week (4), 3 times a week (3). In the subcategory of integration method, it was found that most of the classroom teachers did not give any information about the integration method and most of the participants answered 'always' to the frequency of using new approaches. Below is the interview recording of the teacher-coded T3.

R: *How often do you use the new approaches you prefer in mathematics teaching and how do you integrate them into the teaching process?*

T3: *I try to use new approaches in my teaching as much as possible, if I have to say one lesson hour, I use 3 hours of my 5-hour weekly mathematics lesson by integrating new approaches in my teaching. I do this by preparing my activities and materials according to the approach I have chosen when preparing my lesson plan.*

The answers to the fifth question of the research, "In which subjects do you use the new approaches you prefer in mathematics teaching?" are presented in Table 6.

Table 6

Subjects in which New Approaches to Teaching Mathematics are Used, according to Classroom Teachers

Category	Codes	Frequency (f)
Preferred Mathematics Subjects	All subjects	14
	Fractions	13
	Operations with natural numbers	12
	Problem-solving	12
	Geometric objects and shapes	10
	Measurement	8
	Geometric patterns	3

An analysis of Table 6 shows that the classroom teachers' responses to the subjects in which new approaches are used in mathematics teaching are as follows: all subjects (14), fractions (13), operations with natural numbers (12), problem-solving (12), geometric objects and shapes (10), measurement (8) and geometric patterns (3). Although the participating classroom teachers stated that they used new approaches to teaching mathematics in all subjects, it can be seen that they used them mainly in fractions. Table 6 shows that the subject in which the participating classroom teachers used new approaches to teaching mathematics the least was geometric patterns. Below is the interview recording of the teachercoded T8.

R: *In which subjects do you use the new approaches you prefer in mathematics teaching?*

T8: *In addition, subtraction, division, multiplication with natural numbers and related problems, geometric shapes, patterns*

The answers to the sixth question of the research "What kind of differentiation techniques do you use with the new approaches you prefer in mathematics teaching?" are given in Table 7.

Table 7

Differentiation Techniques Used in Preferred New Approaches

Category	Subcategory	Codes	Frequency (f)
Situations of Using Differentiation Techniques	Use Differentiation Techniques	Not mentioning the name of differentiation techniques	13
		Station technique	6
		Group research	6
		Role-playing technique	4
		Layered teaching method	3
		complex teaching	2
	Don't Use Differentiation Techniques	Who do not prefer differentiation techniques	8

Looking at Table 7, we can see that the category of using differentiation techniques consists of 2 subcategories: those who use differentiation techniques and those who do not use differentiation techniques. In the subcategory of those who use differentiation techniques; not specifying the name of the differentiation techniques (13), station technique (6), group research (6), role play technique (4), layered teaching method (3), and complex teaching method (2), responses were given. In the sub-category of those who do not use differentiation techniques; it can be seen that 8 participating classroom teachers do not prefer to use differentiation techniques. Below is the interview transcript of the teacher-coded T27.

R: *What kind of differentiation techniques do you use with the new approaches you prefer in mathematics teaching?*

S27: *I use a multi-level teaching method, group research, and station technique. Sometimes I give group research and use a flipped learning strategy.*

The answers to the seventh question of the research "What are your reasons for using new approaches in teaching mathematics?"' are presented in Table 8.

Table 8

Reasons for Using Preferred New Approaches

Category	Subcategory	Codes	Frequency (f)
Reasons for Preference	Reasons for the Learning Process	Provides permanent learning	14
		Making learning easier	12
		Ensuring participation in class	11
		Creating a fun learning environment	8
		Increasing interest	6
		Provide concretization	2
	Reasons for Skill Development	Gaining critical and versatile thinking skills	6
	Reasons for the Student	Suitable for student-level	2
		Being student-centered	2
	Reasons for the Age We Live in	Being in line with the times	3
	Real Life Reasons	Ability to use in daily life	2

An analysis of Table 8 shows that the category of reasons for preference consists of 5 subcategories: reasons for the learning process, reasons for skill development, reasons for the student, reasons for the current era, and reasons for real life. In the sub-category of reasons for the learning process, it can be seen that the reasons for using new approaches are that they provide continuous learning (14), facilitate learning (12), provide participation in the lesson (11), create a fun learning environment (8), increase interest (6) and provide concretization (2). In the sub-category of skill development reasons, the responses are that it provides critical and versatile thinking skills (6); in the sub-category of student reasons, it is appropriate to the student level (2) and it is student-centered (2); in the sub-category of age reasons, it is appropriate to the age (3); in the sub-category of real life reasons, the responses are that it can be used in everyday life (2). According to the participating classroom teachers, the table shows that the most common reasons for using the preferred new approaches are that they provide continuous learning and facilitate learning. Below is the interview recording of the teacher-coded T24.

R: *What are your reasons for using the new approaches you use in mathematics teaching?*

T24: *It enables the students to understand more easily the subjects that they find difficult to perceive in the abstract. It keeps students active in the lesson. It keeps students focused on the lesson. It minimizes student boredom.*

The answers to the eighth question of the research "What are the difficulties you have experienced in implementing the new approaches you use in mathematics teaching?" are given in Table 9.

Table 9

Difficulties Encountered in İmplementing New Approaches

Category	Subcategory	Codes	Frequency (f)
Difficulties Encountered	Sourced from the Student	Loss of class dominance	10
		High number of students	9
		Differences in students' learning levels	6
		Students' perspective	3
	Due to Time	be time consuming	14
	Sourced from the Teacher	Lack of technical knowledge	3
		Not having enough information about new approaches	2
	Sourced from Material	Lack of equipment	4
	Sourced from the Curriculum	The topics are intense	3
	Caused by the Environment	Unsuitable classroom environment	2

An analysis of Table 9 shows that the category of difficulties encountered consists of 5 subcategories: student-related, time-related, teacher-related, material-related, curriculum-related, and environment-related. In the student-related subcategory, loss of classroom dominance (10), large number of students (9), different learning levels of students (6), students' point of view (3); in the time-related subcategory, time-consuming (14); in the teacher-related subcategory, insufficient technical knowledge (3) and insufficient knowledge of new approaches (2); in the material-related subcategory, lack of tools and equipment (4); in the curriculum-related subcategory, intensive subjects (3); and in the environment-related subcategory, inappropriate classroom environment (2). According to the participating classroom teachers, the main difficulty in implementing new approaches is that new approaches are time-consuming. Below is the interview recording of the teacher-coded T4.

R: *What are the difficulties you have encountered in implementing the new approaches you use in mathematics teaching?*

T4: *The number of pupils is high, there are differences in level between pupils. It is tiring and time-consuming for teachers to prepare, implement and evaluate.*

The answers to the ninth question of the research "What are the new approaches that you know about but do not use in teaching mathematics?"" are given in Table 10.

Table 10

New Approaches Known But Not Used by Classroom Teachers

Category	Codes	Frequency (f)
Non-Preferred Approaches	STEM education	11
	Flipped learning	9
	Project-based mathematics teaching	5
	Art-based mathematics education	3
	Differentiated instruction	2
	Creative drama	2
	Technology-supported mathematics teaching	2
	Collaborative learning	2

An analysis of Table 10 shows that the classroom teachers gave examples of STEM education (11), flipped learning (9), project-based mathematics teaching (5), arts-based mathematics teaching (3), differentiated teaching (2), creative drama (2), technology-enhanced mathematics teaching (2) and collaborative learning (2) as new approaches that they knew about but did not use. From the table, it can be seen that the most common new approaches that the participating classroom teachers were aware of but did not prefer to use were 'STEM education' and 'flipped learning'. Below is the interview recording of the teacher-coded T7.

R: *What are the new approaches that you know about but do not use in mathematics teaching?*

T7: *I know many of them such as flipped learning, STEM education, and collaborative teaching, but I can't always use them, either there is not enough time or they are not suitable for every student in my class.*

The answers to the question "What do you think about the advantages and disadvantages of the new approaches you use in mathematics teaching in the teaching process?" are presented in Table 11.

Table 11

Classroom Teachers' Opinions on The Advantages and Disadvantages of The New Approaches in The Teaching Process

Category	Subcategory	Codes	Frequency (f)
Opinions on the Teaching Process	Advantages	Provides permanent learning	18
		Making lessons interesting and fun	15
		Ensuring participation in class	10
		Providing convenience in the teaching process	6
		Providing effective teaching	5
		Relating to daily life	4
		Contributing to versatile development	3
		Providing diversity in teaching	3
	Disadvantages	Takes time	21
		Difficulties encountered in the application process due to the large number of students	7
		Lack of opportunities	5
		Makes classroom management difficult	4

When analyzing Table 11, the category of opinions about the teaching process was divided into two subcategories: advantages and disadvantages. In the subcategory of advantages, the participating classroom teachers used the expressions providing continuous learning (18), making

lessons interesting and fun (15), providing participation in lessons (10), providing convenience in the teaching process (6), providing effective teaching (5), associating with everyday life (4), contributing to multidimensional development (3) and providing diversity in teaching (3). In the sub-category of disadvantages, it can be seen that they included the statements that it takes time (21), difficulties in the implementation process due to the high number of pupils (7), lack of facilities (5), and makes classroom management difficult (4). Below is the interview transcript of the teacher-coded T8.

R: *What do you think about the advantages and disadvantages of the new approaches you use in teaching mathematics?*

T8: *The advantage of teaching with new approaches is that the students are more active and the knowledge is more permanent. The disadvantage is that it takes a lot of time and not every student is suitable for every approach in every subject. There is a curriculum that we have to implement. Time is short and sometimes we have to leave activities unfinished. Homework does not contribute enough to the teaching process.*

According to the participating classroom teachers, it is clear from the table that the main advantage of the new approaches used in mathematics teaching is that they provide continuous learning and the disadvantage is that they take time. Some of the participants' answers to this question are given below.

4. Discussion and Conclusion

In this part of the study, the results of the research are summarised, compared with the relevant literature, and discussed. In the first question of the study, classroom teachers indicated that the new approaches they used most in mathematics teaching were technology-enhanced mathematics teaching and problem-based mathematics teaching. These approaches were followed by cooperative learning and realistic mathematics teaching approaches, respectively. Köysüren and Üzel (2018) concluded that the use of technology in mathematics teaching increased the mathematical literacy self-efficacy of 6th-grade students. In their study, Boz and Özerbaş (2020) concluded that classroom teachers' perceptions of the use of technology in mathematics education were positive. The reason why the participants mostly used technology-supported mathematics lessons in mathematics teaching may be that instructional technologies serve the purpose of mathematics teaching and facilitate the teaching process. Taşkaya and Kösece (2015), in their study, stated that the problem-solving method is one of the most used methods by classroom teachers in mathematics education. It was understood that the participants used flipped learning and project-based mathematics teaching approaches, at least in mathematics classes.

When analyzing the results of the category of characteristics that distinguish new approaches from traditional approaches for the second research question, according to the opinions of the participating classroom teachers, the difference between the new approaches they use in mathematics teaching from traditional approaches is most evident in terms of the effectiveness of class participation. In his study, Yağan (2021) concluded that student-centered methods, techniques, and strategies have a moderate effect on positively improving students' attitudes. In their study, Demirdöğen and Kaçan (2010) concluded that the course taught according to realistic mathematics education was significantly more effective than the traditional teaching approach between the success of the experimental and control groups in teaching the fractions concept.

When analyzing the results of the category of contribution to teaching processes for the third research question, it was concluded that two subcategories emerged. In the subcategory of effects on class participation, it was concluded that there was an increase in-class participation, an

increase in interest and motivation, and an increase in confidence in class participation. In his study, Topan (2013) concluded that student-centered methods in mathematics education have a positive effect on both academic achievement and attitudes toward the course compared to the traditional method.

Looking at the results of the category types of integration and frequency of use for the fourth research question, it can be seen that it is divided into two subcategories. In the subcategory of type of integration, it was observed that most of the classroom teachers did not give any information about the type of integration. In the subcategory of frequency of use, there are opinions of class teachers who used the expressions always, according to the appropriateness of the acquisition, very often, 1-2 times a week, 3 times a week. Erduran and Tataroğlu Taşdan (2018) examined the process of integrating technology into the classroom and concluded that pre-service mathematics teachers had difficulties in integrating technology into mathematics education.

Examining the results of the category of preferred mathematics subjects for the fifth question of the research, it can be seen that the participating classroom teachers stated that they used new approaches in teaching mathematics in all subjects, but mostly in fractions. Altındal (2019) concluded that there was a significant difference in favor of the experimental group between the mean scores of achievement, retention test, and attitude scale of the students in the experimental group using the creative drama method in the sub learning area of addition with natural numbers and the students in the control group using the activities in the curriculum. Çilingir Altıner and Artut (2017) conducted a study in which the subject "geometric shapes and measurement" at the fourth-grade level of primary school was taught as a requirement of realistic mathematics education in the experimental group and as a normal course in the control group. In line with the results of the study in the related field, it can be said that the use of new approaches in the teaching process of mathematics subjects has a positive effect on students' achievement.

When analyzing the results of the sixth research question, the use of differentiation techniques, two subcategories emerged. In the subcategory of those who use differentiation techniques, it was seen that 13 classroom teachers did not specify the name of the differentiation technique they used. The reason for this may be that the classroom teachers do not have the necessary knowledge and experience of differentiation techniques, or that they did not think of them at that moment. Demirkaya (2018) found that classroom teachers need theoretical and practical training in differentiated instruction. Ekinci and Bal (2019) concluded that the differentiated instruction approach increased students' mathematics achievement.

When analyzing the results of the category of reasons for preference for the seventh research question, it can be seen that five sub-categories emerged. In the sub-category of reasons for the learning process, the reasons for using new approaches, according to the classroom teachers, are mainly the effects of providing continuous learning, facilitating learning, and ensuring participation in the lesson. In addition, according to Atay (2023), teachers' use of more effective methods in mathematics education can be effective in increasing students' interest and participation and in making mathematics education more meaningful and enjoyable. Kösece and Taşkaya (2015), in their study, also concluded that classroom teachers seek the characteristic of facilitating learning in the selection of methods used in mathematics teaching. These studies in the literature support the findings of this study.

When analyzing the results of the category of difficulties encountered for the eighth question of the research, it was concluded that six subcategories emerged. In the sub-category arising from the pupils, the difficulties experienced were mainly the loss of classroom dominance and the large number of pupils. In the sub-category arising from the teacher, the difficulties experienced,

according to the participating classroom teachers, were mainly the lack of technical knowledge. In their study, Yılmaz, Korkmaz, and Kurt (2023) concluded that classroom teachers may experience some negative situations such as experiencing problems related to time, difficulties in applying in crowded classes, and difficulties in classroom management while applying creative drama from new approaches.

Regarding the ninth question of the study, it is understood that the new approaches that classroom teachers are aware of but do not use are mostly STEM education and flipped learning approaches. Köse and Ataş (2020) evaluated the opinions of classroom teachers on STEM education and found that teachers had difficulties in terms of material supply and course duration during STEM education practices and that teachers should be supported by the Ministry of National Education with training to effectively implement STEM education in classrooms. In their study, Alagöz and Sözen (2021) found that classroom teachers considered STEM education necessary but faced difficulties in implementation and integration problems due to reasons such as curriculum intensity, lack of knowledge and experience.

When the results of the category of opinions about the teaching process for the tenth research question were analyzed, it was found that they were grouped into two subcategories. According to the opinions of the classroom teachers in the advantages subcategory, the greatest advantages of the new approaches used in the teaching process are that they provide continuous learning and make the lessons interesting and enjoyable. Çırak and Uygun (2023) stated in their study that teachers should use technological tools to increase students' interest in mathematics and to facilitate their understanding of mathematical knowledge. In their study, Güneş and Buluç (2017) stated that the advantage of technology in terms of time, labor, and speed is one of the biggest reasons for preferring technology and that technology is important for the last lesson in terms of motivating students for the lesson and increasing teacher effectiveness. In this study, technology-supported mathematics teaching was the most frequently used approach in mathematics teaching according to the classroom teachers' opinions.

Based on these findings, it is recommended that classroom teachers should use more new approaches in mathematics education and that classroom teachers should be trained on new approaches to use new approaches in mathematics education correctly and effectively.

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Ethics Committee Approval:

In this study all rules were followed stated in the directive of Scientific Research and Publication Ethics of Higher Education Institutions. Approval was received from Kahramanmaraş Sütçü İmam University Social and Human Sciences Ethics Committee of 17.07.2024, dated and numbered E-72321963-050.04-327794.

Research Article

Asian Journal of Instruction
Asya Öğretim Dergisi

2024, 12(2), 21-37

dergipark.gov.tr/aji
ISSN:2148-2659

Received: 23/11/2023 Accepted: 06/11/2024 Published: 31/12/2024

Impact of STEM on Primary School Students' 21st Century Skills, NOS, and Learning Experiences*

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Yıldız, M., & Ecevit, T. (2024). Impact of STEM on primary school students' 21st century skills, NOS, and learning experiences. *Asian Journal of Instruction, 12*(2), 21-37. Doi: 10.47215/aji.1395298

Abstract

This study examines the influence of STEM activities on fourth-grade students' 21st-century skills, their understanding of the nature of science (NOS), and their overall learning experiences. The research was conducted during the autumn term of the 2021–2022 academic year at a public primary school with a relatively low socioeconomic status. Over six weeks, STEM activities were integrated into the "Earth's Crust and the Movements of Our Earth" unit in the Science curriculum. A mixed-method approach was employed, encompassing a quasi-experimental pretest-posttest control group design for the quantitative phase and a case study approach for the qualitative phase. The sample included 35 fourth-grade students. Data were obtained using the "21st Century Learning and Innovation Skills Scale," the "Ideas About the Nature of Science Scale," and unstructured observation notes. The findings indicated statistically significant improvements in the experimental group's 21st-century skills, particularly creativity, innovation, critical thinking, and problem-solving. Moreover, the activities fostered enhanced cooperation and communication skills. Based on post-test results, the student's understanding of the NOS also improved significantly. Qualitative analysis of teacher observation notes supported these outcomes, showing heightened student engagement, enjoyment, and active participation. Students produced more creative and reflective responses to scientific concepts, while their collaborative and communicative competencies were notably strengthened. In sum, STEM activities embedded within the 5E teaching model enriched the learning process by promoting scientific curiosity, critical thinking, and sustained motivation. Students' requests for similar activities in other courses further underscored these interventions' positive impact and enduring appeal.

Keywords: 21st century skills, learning experiences, nature of science (NOS), primary school students, STEM education

1. Introduction

Today, with rapid technological advancements, the rise of artificial intelligence, and the impact of digitalization, the Fourth Industrial Revolution is unfolding (Turan, 2018). This process underscores the growing importance of individuals' ability to adapt to rapidly changing economic, technological, and social conditions. In response, educational reforms are being implemented to prepare individuals for the demands of the 21st-century economy (National Research Council [NRC], 2012; Next Generation Science Standards [NGSS], 2013). The direct link between these reforms and economic success is evident in international assessments (Organization for Economic

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Co-operation and Development [OECD], 2010). For instance, countries such as South Korea, China, and Japan have enhanced their economic performance through educational reforms.

In modern business and social life, individuals must think creatively and critically, collaborate effectively, use technology proficiently, develop practical solutions to everyday problems, manage information efficiently, and maintain productivity to lead a successful life (TUSIAD, 2014). These abilities, often referred to as 21st-century skills (Partnership for 21st Century Learning [P21], 2009; Yaşar, 2021), are essential for adapting to the rapidly evolving landscape of science, technology, and industry (Keleşoğlu & Kalaycı, 2017). Over the past decade, numerous studies have aimed to identify the life, career, and learning skills necessary in the 21st century (Ananiadou & Claro, 2009; Beers, 2011; Bybee, 2009; P21, 2009).

Cultivating proficiency in science, technology, engineering, and mathematics (STEM) has emerged as a critical educational priority (Bybee, 2010; NRC, 2012). Uluyol and Eryılmaz (2015) categorized 21st-century skills as problem-solving, communication, cooperation, accessing scientific knowledge, evaluating information through technology, and demonstrating responsibility. Sen, Ay and Kiray (2018) emphasized engineering-based collaboration, design, creativity, innovation, and digital literacy competencies. Beers (2011) highlighted essential skills in knowledge management, life skills, communication, career development, problem-solving, cultural awareness, and critical thinking. While definitions and categories vary, the broad consensus is that these skills equip individuals with practical competencies for a knowledge-based, technology-driven, and economically oriented society (OECD, 2012; Trilling & Fadel, 2009; Wagner, 2008). Critical thinking, creativity, collaboration, and problem-solving are frequently emphasized across different frameworks (Belet-Boyacı & Güner-Özer, 2019). These skills are also fundamental for adapting to emerging professions shaped by rapid technological changes, many of which align with STEM careers (Langdon, Mckittrick, Beede, Khan, & Doms, 2011). STEM education thus aims to equip individuals with these competencies, enabling students to research, develop, and analyze information to address real-world problems (Beers, 2011).

With its dynamic and evolving nature, science permeates all aspects of life. Due to its expansive scope, defining science can be challenging. The Turkish Language Association (2022) defines *science* as "organized knowledge that selects a portion of the universe or events as its subject and seeks to draw conclusions using methods based on experimentation and reality." Science is characterized by rationality and encompasses various branches, including processes for understanding and interpreting data (Hastürk, 2017).

Given the increasing importance of science, understanding scientific knowledge and the nature of science (NOS) has become critical. Turkey's curriculum reforms in 2005 aimed to enhance students' understanding of NOS and foster scientific literacy (MoNE, 2005). The concept of NOS includes the framework of science, the organization of scientific research, and the development of scientific knowledge. It is commonly defined as the characteristics of scientific knowledge and the values inherent in its development (Lederman & Zeidler, 1987). It also refers to understanding how knowledge is produced, evolves, and can be reused (MoNE, 2013).

The literature suggests a significant relationship between STEM and NOS. STEM inherently reflects the nature of science, mainly through its interdisciplinary approach (Ozan & Uluçınar-Sağır, 2020). Koştur (2017) emphasized that STEM activities require students to think like engineers or scientists, with NOS as a foundational component of STEM education. Research trends in STEM studies focus on secondary school students, with attitudes and achievements frequently examined variables (Ecevit, Yıldız, & Balcı, 2022). However, there is limited research on STEM activities at the primary school level, especially regarding NOS (Çalışkan & Okuşluk, 2021).

This study contributes to the literature by addressing these gaps and providing practical tools for educators and researchers, such as detailed lesson plans (Appendix 1). Its significance lies in exploring the effects of STEM activities, implemented through the 5E learning model, on primary school students' 21st-century skills and NOS thinking. While related studies have investigated these skills, few focus on the primary level. This research offers valuable insights to guide teachers and researchers, including lesson plans, sample activities, and student feedback.

Research Questions

This study examines the effects of STEM activities on students' 21st-century skills and NOS thinking. The main research questions are:

1. Do STEM activities in science courses enhance primary school students' 21st-century learning and innovation skills?
2. Do STEM activities in science courses improve primary school students' understanding of the nature of science?
3. What are the contributions of STEM activities to primary school students' learning experiences?

2. Method

2.1. Research Model

This study employed a mixed-method research approach combining quantitative and qualitative methodologies to examine the effects of STEM activities on fourth-grade primary school students' 21st-century skills and their understanding of the nature of science (NOS). The quantitative component of the study utilized a quasi-experimental design with a pretest-posttest control group (Karasar, 2004), while the qualitative component adopted a case study design (Yıldırım & Şimşek, 2021).

An embedded mixed-method research design was chosen to investigate students' NOS perspectives and their learning experiences during STEM activities. In this approach, the primary quantitative method addresses the main research questions, while the qualitative method provides complementary insights to explain specific aspects of the data in depth (Creswell & Plano Clark, 2007).

The quantitative dimension, as the main component of the research, employed a pretest-posttest control group quasi-experimental design (Karasar, 2004). Participants were divided into experimental and control groups: STEM activities were implemented for the experimental group, while traditional teaching methods were applied to the control group. Quantitative data were collected using scales measuring 21st-century skills and students' NOS perspectives. These scales were administered as pretests and posttests to evaluate the impact of STEM activities on students' development in these areas.

The qualitative dimension provided a supportive perspective to enrich the research findings. In this dimension, a case study design was employed to explore students' experiences and the effects of STEM activities in depth (Yıldırım & Şimşek, 2021). Case studies focus on detailed examinations of individuals or groups within specific contexts. In this study, unstructured observation notes were collected by the teacher to document the impact of STEM activities on students' learning experiences. These observations occurred naturally during classroom STEM activities, capturing students' behaviors, emotional responses, and overall engagement.

2.2. Study Group

The study group comprised fourth-grade students attending a public school in the central district of Düzce province during the fall semester of the 2021–2022 academic year. A total of 35 students participated in the quantitative component of the study, divided into experimental and control groups. Among these participants, 20 were female, and 15 were male. The experimental group included nine females and six male students, while the control group consisted of eleven female and nine male students.

For the qualitative component, data were collected exclusively from the experimental group to explore their learning experiences during the STEM activities. Observations focused on students' engagement and responses to the activities throughout the implementation process.

2.3. Equivalence of the Groups

To ensure the comparability of the experimental and control groups, a t-test was conducted to analyze their prior science achievement scores, obtained from the e-school system. The average science achievement score for the experimental group was 2.73, while the control group's average score was 2.65. Statistical analysis [$t(33) = 0.512$, $p > 0.05$] revealed no significant difference between the groups in terms of prior science achievement. Thus, it was determined that the experimental and control groups were equivalent with regard to their initial levels of science achievement, ensuring a fair comparison of the impact of STEM activities.

2.4. Data Collection Tools

2.4.1. *Quantitative Data Collection Instruments*

Since the study was conducted with fourth-grade primary school students, the '21st Century Learning and Renewal Skills Scale' developed by Boyacı and Atalay (2016) was employed. In their reliability study conducted with 609 fourth-grade students during the 2014–2015 academic year, the overall reliability coefficient of the scale was calculated as .95. The reliability values for the sub-dimensions were as follows: creativity and renewal (.95), critical thinking and problem-solving (.94), and cooperation and communication skills (.89). Prior to this study, a reliability analysis was conducted with 123 fourth-grade students, yielding reliability values of .87, .75, .67, and .71 for the respective sub-dimensions. According to Büyüköztürk et al. (2010), these values indicate that the scale demonstrates acceptable reliability.

The 'Students' Ideas about Nature of Science (SINOS)' scale**,** originally developed by Chen et al. (2013) and adapted into Turkish by Cansız et al. (2017), was also used in this study. The Turkish version of the scale comprises seven sub-dimensions: theory-ladenness and subjectivity, creativity and imagination, changeability, durability, consistency and objectivity, science for girls, and science for boys. In its adaptation study, the scale was administered to 380 secondary school students and reported a reliability value of .85 (Cansız et al., 2017). Since the original study group consisted of secondary school students, modifications were made to adapt the scale for primary school students. These adaptations included converting the scale into a three-point Likert-type format based on expert consultations and obtaining the necessary permissions. Additionally, certain sub-dimensions, such as theory-ladenness and subjectivity, creativity and imagination, and consistency and objectivity, were excluded to better align with the developmental level of primary school students. Following these adjustments, the adapted version of the scale consisted of 14 items. In a reliability analysis conducted with 64 primary school students, the revised scale yielded a reliability coefficient of .69, indicating acceptable reliability for this study.

2.4.2. *Qualitative Data Collection Instruments*

In this study, unstructured observation notes**,** taken by the teacher served as the qualitative data collection tool. These notes documented the behaviors, impressions, and teacher-student interactions observed in the experimental group during their participation in STEM activities. After each lesson, the teacher recorded detailed observations regarding students' responses, levels of engagement, and collaboration throughout the activities. The purpose of these observations was to provide a comprehensive understanding of the impact of STEM activities on students' learning experiences and the overall process. The collected data were analyzed using thematic analysis**,** which allowed for a deeper exploration of the effects of STEM activities on students' engagement, collaboration, and learning outcomes.

2.5. Implementation Process

The researcher developed the lesson plans and activities used in this study, incorporating expert opinions at every stage of the preparation process. The activities were carefully designed to align with the primary school students' developmental level and the study's objectives. The lesson plans were structured around the 'Earth's Crust and the Movements of Our Earth' unit within the fourth-grade Science curriculum. STEM activities were integrated into the lessons and implemented over eight weeks to ensure alignment with the curriculum and the study's goals.

Table 1

Implementation Process by Weeks

Weeks	Lesson Plan	Activities	Steps of Activities
Week 1		Pre-Test	
Week 2	1.Lesson Plan	Activity 1: Rock Cards	Explore
		Activity 2: Rock Investigation	Explain
		Activity 3: Stone Collecting	Elaborate
Week 3	2.Lesson Plan	Activity 4: Paleontologist Task Fossils	Elaborate
Week 4	3.Lesson Plan	Activity 5: Travelling to Space	Elaborate
Week 5	4.Lesson Plan	Activity 6: Sundial	Elaborate
Week 6	5.Lesson Plan	Activity 7: Building my own Satellite	Explain
Week 7	6. Lesson Plan	Activity 8: Landing on Mars	Elaborate
Week 8		Post-Test	

In the control group, lessons were conducted using a teacher-centered approach, where the teacher primarily assumed the role of a lecturer. The instruction predominantly relied on the question-and-answer technique**,** and a world model along with a flashlight were used as instructional tools to support the unit content. Lessons were structured around the textbook commonly used in schools, with students expected to take notes on key points as directed by the teacher. At the end of each topic, tests were administered to evaluate students' understanding and retention of the material.

2.6. Data Analysis

2.6.1. *Analysis of Quantitative Data*

Quantitative data obtained from the 21st Century Learning and Renewal Skills Scale were analyzed using dependent and independent samples t-tests**,** as the data satisfied the assumptions of normality ($p > .05$) and homogeneity ($p > .05$). In contrast, data collected using the Ideas About the Nature of Science Scale did not meet the assumption of normality ($p < .05$). Consequently,

non-parametric tests, including the Mann-Whitney U test and the Wilcoxon Signed Rank Test, were employed for analysis.

2.6.2. *Analysis of Qualitative Data*

Qualitative data collected through teacher observation notes during STEM activities were analyzed using thematic content analysis to understand their impact on students' learning experiences. After the coding process, the data were organized into sub-categories, categories, and main themes. To enhance the reliability of the analysis, 10% of the data was independently coded by two researchers, achieving an inter-coder agreement rate of 77%. This calculation followed the reliability formula recommended by Miles and Huberman (1994)**.** Relationships among the derived themes were further examined to develop a comprehensive perspective on the learning process.

2.7. Ethics Committee Permission

All procedures in this research complied with the principles outlined in the Directive on Scientific Research and Publication Ethics of Higher Education Institutions. Ethical approval for the study was obtained from the Düzce University Graduate Education Institute Ethics Committee, with the decision dated 30.09.2021 and numbered 2021-231.

3. Findings

3.1. Findings Related to 21st Century Learning and Renewal Skills

The 21st Century Learning and Renewal Skills levels of students in the experimental and control groups were compared using a t-test. The pretest mean score for the experimental group was 2.34, while the control group had a pretest mean score of 2.31. The analysis results [t(33) = 0.336, p > 0.05] indicated no statistically significant difference between the groups, suggesting that both groups were at a comparable level in terms of 21st-century skills prior to the intervention.

Table 3 presents the results of the t-test examining the significance of differences between the posttest scores of the experimental and control group students on the '21st Century Learning and Renewal Skills Scale'.

Table 3

21st Century Learning and Renewal Skills Scale Intergroup Posttest T-Test Results

Dimensions	Group	N	X	SS	sd	t	p
21st Century Learning and Renewal Skills Scale	Experiment	15	*2.49*	.189	33	3.387	*.002**
	Control	20	2.28	.169			
Creativity and Renewal Sub-dimension	Experiment	15	*2.51*	.184	33	4.031	*.000**
	Control	20	2.28	.158			
Critical Thinking and Problem Solving Sub-dimension	Experiment	15	*2.37*	.224	33	2.716	*.046**
	Control	20	2.22	.269			
Cooperation and Communication Sub-dimension	Experiment	15	*2.64*	.263	33	2.015	.052
	Control	20	2.62	.242			

The mean posttest score of the experimental group students on the overall 21st Century Learning and Innovation Skills Scale ($\bar{X}$posttest = 2.49) was statistically significantly higher than the mean score of the control group students ($\bar{X}$posttest = 2.28). The t-test analysis indicated that this difference was significant in favor of the experimental group [t(33) = 3.387, p< .05].

In the Creativity and Innovation sub-dimension, the mean posttest score of the students in the experimental group ($\bar{X}$posttest = 2.51) was statistically significantly higher than the mean score of the students in the control group ($\bar{X}$posttest = 2.28) [t(33) = 4.031, p< .05].

In the Critical Thinking and Problem-Solving sub-dimension, the mean posttest scores of the students in the experimental group ($\bar{X}$posttest = 2.37) were also statistically significantly higher than those of the control group ($\bar{X}$posttest = 2.22) [t(33) = 2.716, p< .05].

In the Cooperation and Communication subdimension, the mean posttest scores of both the experimental ($\bar{X}$posttest = 2.64) and control ($\bar{X}$posttest= 2.62) group students were higher than those in other subdimensions. However, the activities did not have a statistically significant effect on improving the students' cooperation and communication skills [t(33) = 2.015, p > .05].

3.2. Findings Related to Thoughts on the Nature of Science

Since the scale scores of the students in the experimental and control groups did not follow a normal distribution, they were analyzed using the Mann-Whitney U test. The comparison of the pretest rank averages [U(N_{exp} = 15, $N_{control}$ = 20) = 93.500, z = -1.899, p > .05] indicated no statistically significant difference between the groups. This result suggests that the students in the experimental and control groups were similar in terms of their initial thoughts on the nature of science.

The change in the posttest scores of the students in both groups, with respect to their thoughts on the nature of science, was also evaluated using the Mann-Whitney U test, and the results are presented in Table 4.

Table 4

Posttest Mann-Whitney U Test Results of Thoughts on the Nature of Science Scale Between Groups

Group	N	Posttest X	Rank Mean	Row Total	U	p
Experiment	15	2.42	21.63	324.5	95.500	.067
Control	20	2.26	15.28	305.5		

The mean posttest score of the experimental group students ($\bar{X}_{posttest}$ = 2.42) was higher than the mean score of the control group students ($\bar{X}_{posttest}$ = 2.26). However, the results of the Mann-Whitney U test indicate that this difference is not statistically significant [U (N_{exp} = 15, $N_{control}$ = 20) = 95.500, z = -1.829, p > .05].

3.3. Contributions of STEM Applications to Students' Learning Experiences

Teacher observation notes were recorded in an unstructured format to document students' learning experiences during STEM activities in detail. For instance, notes were taken on students' engagement, prior knowledge levels, curiosity, and peer discussions on topics like the shape of the Earth, space, and rocket design. These observations reflect how students think, learn, and engage in discussions in a natural classroom setting.

To minimize potential bias, the teacher adopted an interactive yet non-intrusive observer role, maintaining the notes in a format that aimed to objectively capture student behaviors and interactions.

When the teacher observation notes were systematically analyzed, the emerging themes, categories, and subcategories are presented as a schema in Figure 1.

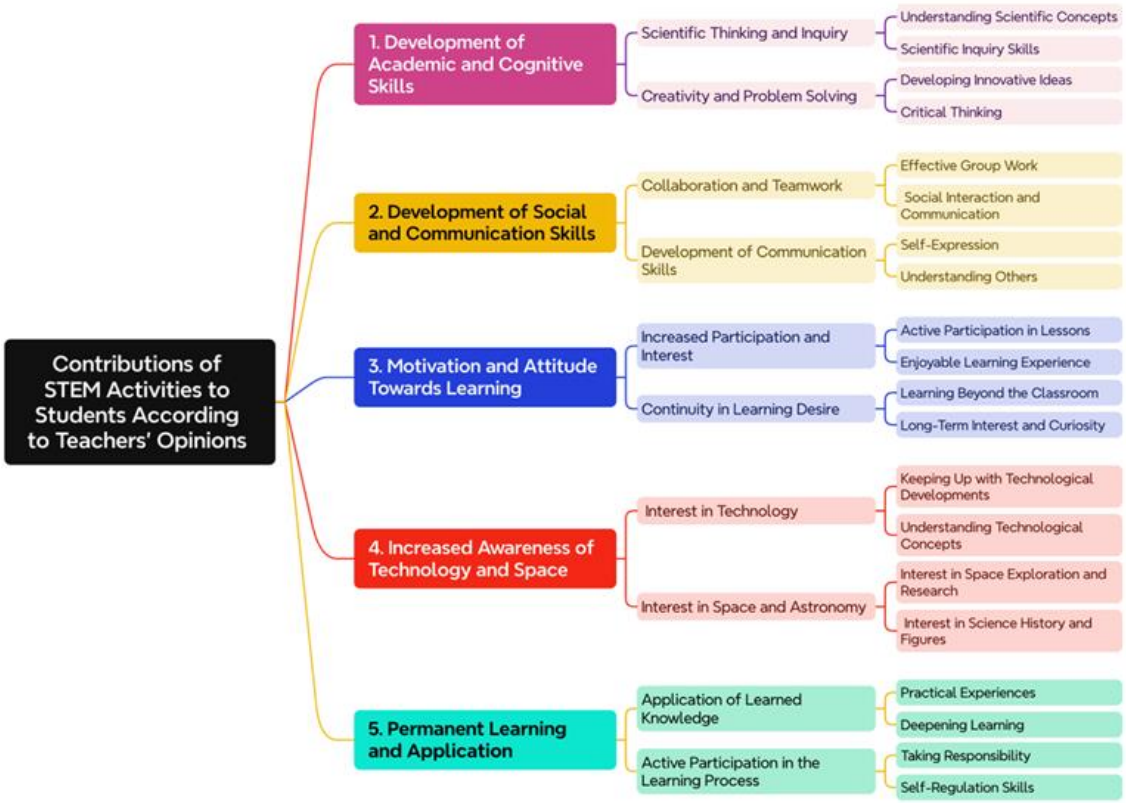

Figure 1. *Contributions of STEM Activities to Students' Learning Experiences: Schema of Themes, Categories, Subcategories*

The findings from teacher observation notes show that STEM activities have a multidimensional effect on students, manifesting in various areas such as cognitive development, social skills, motivation, and technology awareness.

3.3.1. Development of Academic and Cognitive Skills

STEM activities significantly enhanced students' scientific thinking, creativity, and problem-solving abilities. Students demonstrated a deeper understanding of scientific concepts, improved questioning skills, and engaged in creative thinking processes. These activities enabled students to integrate scientific knowledge into daily life rather than simply memorizing course content. For instance, students developed curiosity about fundamental scientific concepts, such as the shape of the Earth and the formation of day and night. They demonstrated their ability to question these ideas. Such scientific inquiry contributes to students' scientific literacy and critical thinking, supporting their future learning processes. Moreover, problem-solving and creativity skills improved as students participated in STEM activities. Through trial and error during experiments, students learned to generate innovative solutions and address practical problems, which increased their confidence in tackling scientific challenges. These enhancements in students' academic and cognitive skills are organized into categories, subcategories, and codes, as illustrated in Figure 2.

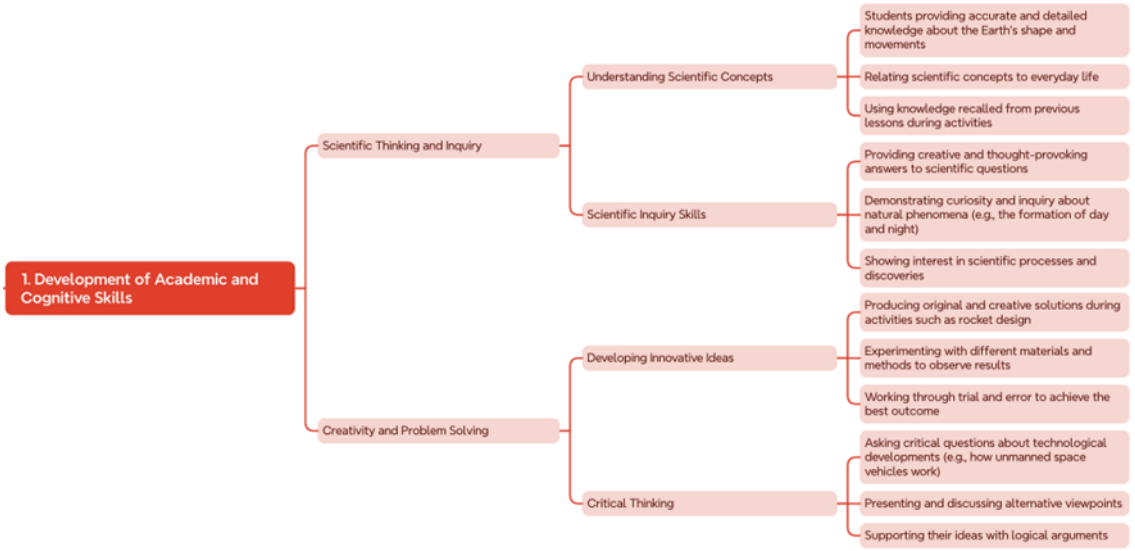

Figure 2. *Categories, Subcategories, and Codes Related to the "Development of Academic and Cognitive Skills" Theme*

3.3.2. Development of Social and Communication Skills

STEM activities also significantly enhanced students' social and communication skills. During group work, students collaborated to produce solutions, improving their communication and social interaction. They exchanged ideas, made decisions, and shared responsibilities within their groups to achieve common goals. This process strengthened their teamwork skills and taught them to take individual responsibility. These social skills enabled students to work more effectively, individually, and collaboratively, providing valuable experience for future projects requiring cooperation. Additionally, improved communication skills empowered students to express their ideas clearly while appreciating the perspectives of others. These observed enhancements in students' social and communication skills are organized into categories, subcategories, and codes, as depicted in Figure 3.

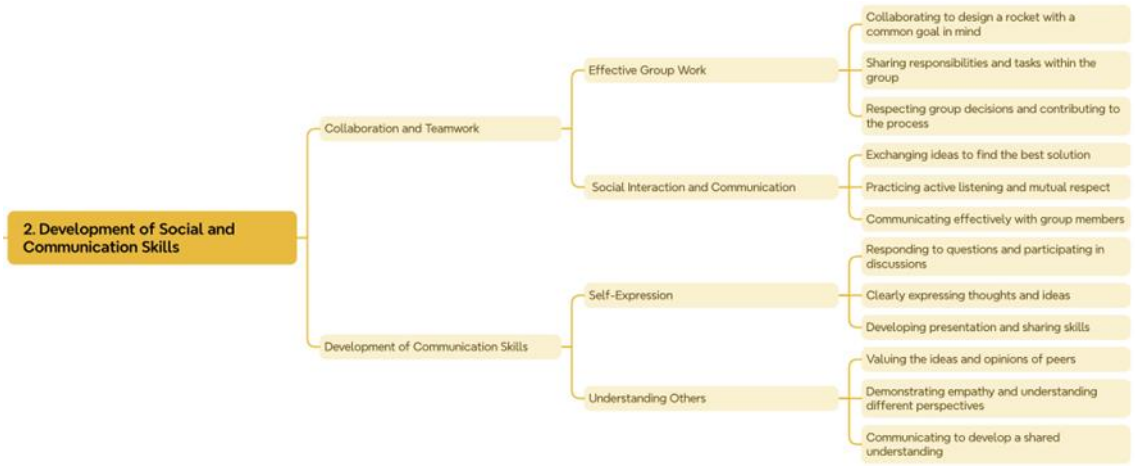

Figure 3. *Categories, Subcategories, and Codes Related to the "Development of Social and Communication Skills" Theme*

3.3.3. Motivation and Attitude Towards Learning

The impact of STEM activities on motivation was evident. Students' interest and participation in lessons increased, with previously disengaged students actively joining the activities. The fun and interactive learning environment fostered positive attitudes toward the subject and cultivated a more favorable perspective on the learning process. Students' willingness to learn outside the classroom also emerged as a long-term effect of STEM activities. Their eagerness to repeat experiments at home or bring objects (e.g., stones) into the classroom for examination demonstrates how the learning process extends beyond the classroom and leaves a lasting impact. Such behaviors maintain students' scientific curiosity and illustrate the sustainability of STEM-based learning. These observed improvements in students' motivation and attitudes towards learning are represented through the categories, subcategories, and codes presented in Figure 4.

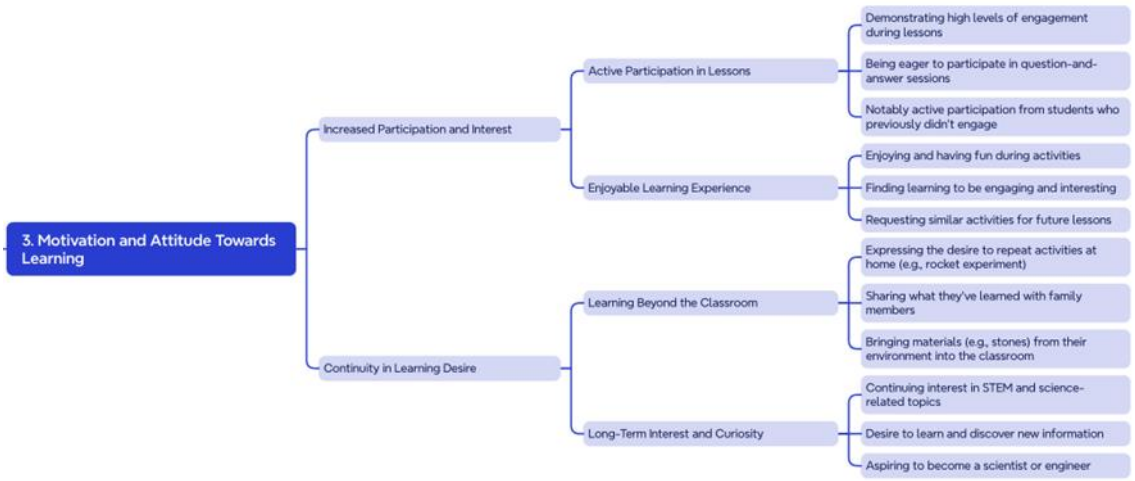

Figure 4. *Categories, Subcategories, and Codes Related to the "Motivation and Attitude Towards Learning" Theme*

3.3.4. Increased Technology and Space Awareness

STEM activities increased students' interest and awareness of technology and space-related topics. For example, their curiosity about Elon Musk's projects and space exploration suggests that STEM activities could inspire some students to pursue careers in these fields. This highlights how STEM activities enhance classroom learning and cultivate a lasting interest in technology and space sciences. This heightened awareness is evidenced by students' desire to learn about current scientific developments and their growing interest in scientific discoveries. Their questions about space exploration and technological advancements demonstrate that these activities deepen students' scientific thinking and increase their likelihood of pursuing careers in STEM-related fields. Figure 5 illustrates the categories, subcategories, and codes associated with the theme of "Increased Technology and Space Awareness," highlighting how STEM activities stimulate students' curiosity about technology and space-related topics, such as space exploration and current scientific advancements.

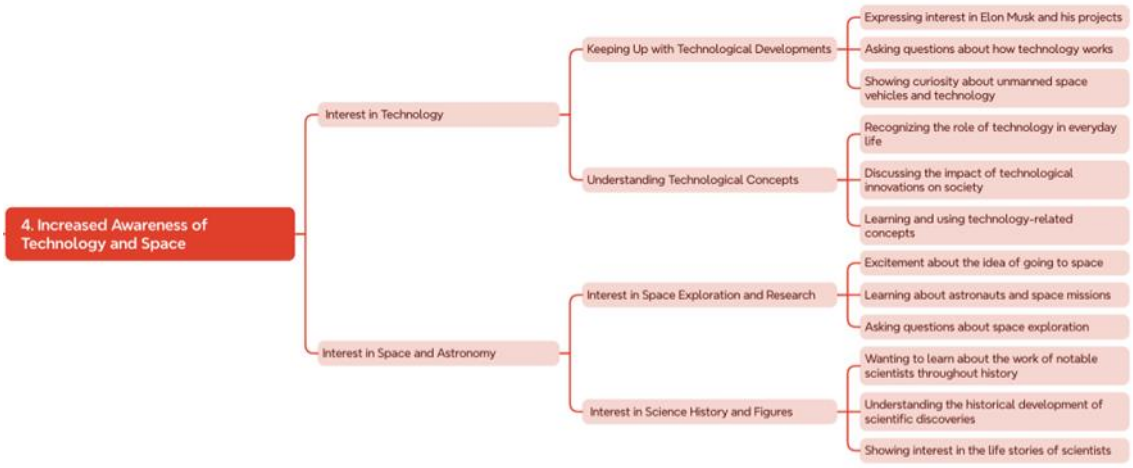

Figure 5. *Categories, Subcategories, and Codes Related to the "Increased Technology and Space Awareness" Theme*

3.3.5. Permanent Learning and Application

STEM activities also profoundly impacted permanent learning. The fact that students revisited and applied the knowledge gained during these activities at home and in daily life suggests that their learning was deepened and more enduring. This permanence indicates that STEM activities are not merely short-term knowledge acquisition exercises but provide students with long-term, practical learning experiences. Following these activities, students often conducted new experiments independently and took greater responsibility for their learning process. Figure 6 presents the categories, subcategories, and codes related to the theme of "Permanent Learning and Application," demonstrating how STEM activities contribute to long-lasting and practical learning experiences that extend beyond the classroom setting.

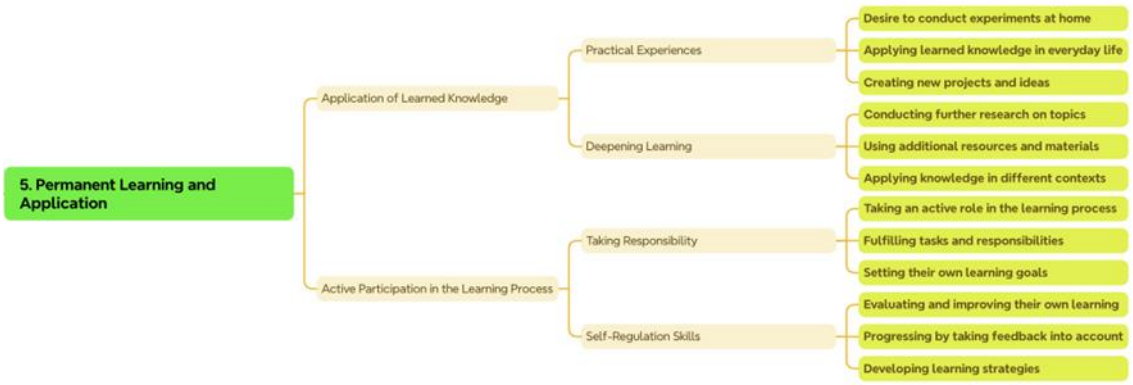

Figure 6. *Categories, Subcategories, and Codes Related to the "Permanent Learning and Application" Theme*

The findings show that STEM activities offer multifaceted benefits to students, fostering scientific thinking, problem-solving, social interaction, and technological awareness. STEM education enhances academic achievement and contributes to students' personal development by improving their social, communication, and motivational skills.

The lasting effects of these activities are reflected in students' positive attitudes toward learning, which extend beyond the classroom. STEM activities equip students with essential skills for advancement in scientific and technological fields while promoting sustained, impactful learning.

4. Conclusion and Discussion

This study evaluated the development of 21st-century skills, understanding of the nature of science (NOS), and learning experiences of fourth-grade primary school students. The effects of STEM applications, which incorporated topics from the 'Earth and Universe' unit in the experimental group and textbook-oriented teaching in the control group, were analyzed.

4.1. 21st-Century Skills

The first sub-problem examined the impact of STEM activities on students' 21st-century skills. Bybee (2010) emphasized that STEM practices enhance productivity and foster 21st-century skills. The results revealed significant differences between the experimental and control groups in favor of the experimental group, underscoring the effectiveness of STEM activities in developing these skills. Post-application analysis of the sub-dimensions of the 21st-century skills scale demonstrated significant improvements in creativity, innovation, critical thinking, and problem-solving among students in the experimental group. While no statistically significant differences were found for collaboration and communication skills, observation notes revealed that these skills were still developed during the STEM activities. Students demonstrated improved communication and a greater tendency to collaborate during group work. These findings align with the literature documenting the positive impact of STEM activities on collaboration and communication skills (Abernathy & Vineyard, 2001; Aydın & Karslı-Baydere, 2019; Dewaters & Powers, 2006; Hiğde, 2018; Karahan, Bilici, & Ünal, 2015; Khanlari, 2013; Morrison, 2006; Özçelik & Akgündüz, 2017; Şahin et al., 2014). Additionally, studies by Yavuz (2019), Capraro and Jones (2013), and Knezek et al. (2013) highlight STEM activities as effective tools for enhancing critical thinking, problem-solving, and creativity. Pekbay (2017) further emphasized the role of STEM activities in improving real-world problem-solving abilities. The results indicate that students in the experimental group outperformed the control group in creativity, innovation, critical thinking, and problem-solving. However, the lack of statistically significant improvement in collaboration and communication suggests that longer-term applications or alternative strategies may be needed to develop these skills further. These findings offer valuable guidance for teachers to effectively design and implement STEM education. The widespread and sustained application of STEM activities could contribute to the balanced development of critical thinking, problem-solving, collaboration, and communication skills.

4.2. Understanding of the Nature of Science (NOS)

The second sub-problem explored students' understanding of NOS. A significant increase was observed in the pretest-posttest scores of the experimental group, indicating that STEM activities contributed to a deeper understanding of NOS concepts and scientific thinking skills. In particular, students recognized that scientific knowledge is evidence-based and scientific processes are multidimensional, highlighting the age-appropriateness of STEM activities for fostering NOS comprehension. While the experimental group's post-test scores were higher than those of the control group, the difference was not statistically significant. This suggests that although STEM activities positively impact NOS understanding, the effect may not be substantial compared to textbook-based teaching. A literature review supports the positive effects of STEM activities on NOS understanding. For example, Bektaş (2011) found that activities designed using the 5E model significantly enhanced NOS comprehension among students. Similarly, Şık (2019) and Eroğlu (2018) documented positive contributions of STEM activities to NOS understanding at

the middle and high school levels. Studies with pre-service teachers (Büber-Kılınç, 2021; Yıldırım et al., 2017) also confirmed similar findings. However, research specifically examining STEM's impact on NOS at the primary school level remains limited, indicating a need for further studies to deepen understanding of its effects on younger students.

4.3. Learning Experiences

Qualitative findings from teacher observation notes revealed that STEM activities had multifaceted and lasting effects on students. These activities enhanced scientific thinking, creativity, and problem-solving skills while fostering social interaction, cooperation, and communication. Increased participation and motivation were observed, with the enjoyable and interactive structure of STEM activities promoting positive attitudes toward learning. Additionally, students exhibited a growing interest in technology and space sciences, fostering long-term curiosity and engagement in these fields. This extended learning beyond the classroom and encouraged sustained interest in scientific exploration.

In conclusion, this study's findings suggest that STEM activities are an effective tool for developing 21st-century skills, understanding the nature of science, and enhancing overall learning experiences at the primary school level. STEM activities' positive contributions to both in-class and out-of-class learning processes underscore the necessity and importance of enriching educational programs with these activities.

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Ethics Committee Permission:

In this study, all rules stated in the 'Directive on Scientific Research and Publication Ethics of Higher Education Institutions' were followed. Ethical approval for this study was obtained from the Düzce University Graduate Education Institute Ethics Committee, with the decision dated 30.09.2021 and numbered 2021-231.

Research Article

Asian Journal of Instruction
Asya Öğretim Dergisi

2024, 12(2), 38-58

dergipark.gov.tr/aji
ISSN:2148-2659

Recieved: 15/05/2024 Accepted: 06/12/2024 Published: 31/12/2024

An Evaluation of Theses and Articles in terms of In-Service Training Needs of Special Education Teachers

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Filiz, S., & Küpçük, G. (2024). An evaluation of theses and articles in terms of in-service training needs of special education teachers. *Asian Journal of Instruction, 12*(2), 38-58. Doi: 10.47215/aji.1484314

Abstract

The study aims to present postgraduate theses and articles regarding in-service training needs of special education teachers in Turkey between 2008 and 2022, examining them by year, type, university, journal, research method, design/model, sample size, data collection tool, data analysis, subject distribution, and suggestions according to the findings and keywords. The data source includes postgraduate theses and articles between 2008 and 2022. Document analysis was used, and the data were analyzed by content analysis. According to the findings, most of the theses and articles used qualitative research methods; the data collection method was mainly semi-structured interviews; the data analysis method was descriptive and content analysis. The subject distribution was gathered under nine different headings, and most studies are teachers' opinions in line with the educational needs of special education students. However, the studies on in-service training needs are much less than other studies. According to the findings, the need for in-service training is highly recommended in the suggestions, and according to the keywords, special education includes many different disciplines. It is essential that special education includes many different disciplines and that teachers have knowledge, skills, and equipment in many disciplines. Quantitative and mixed-design research studies can be carried out, and data collection tools can be developed to examine the in-service training needs of special education teachers in-depth, reveal the needs, and carry out practices. In-service training needs of teachers working in special education can be determined, and more studies can be conducted in this field.

Keywords: Individuals with special needs, in-service training, special education, teacher views, training needs

1. Introduction

Education is the planned design of predetermined goals in line with certain objectives to change and improve people's behaviour, and a series of effects that bring about desired changes in knowledge, skills, values, attitudes, and behaviours in individual (Ertürk, 2017: 13). Education covers all processes, including teaching, learning, knowledge transfer, and skill acquisition activities within these planned or accidental interactions in school, family, or environment, (Akyüz, 2014).

As there are physical individual differences between people, such as height, and weight, there are also differences in learning characteristics (Özdamar, 2016). There are differences in the

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learning speed, style, and behaviour of each individual in practice. While differences in learning are sometimes related to reasons such as living conditions, environment, insufficient experience, or disability diagnosis, they may not be due to any reason (Diken, 2014; Yılmaz & Batu, 2016). On the other hand, special education is a field that covers the education and training processes of individuals who differ from normal children in terms of mental, emotional, and social development (Ataman, 2003: 19). According to the MoNE Regulation on Special Education Services (2018), "special education curriculum are prepared to meet the educational and social needs of individuals who differ significantly in terms of their individual and developmental characteristics and educational competencies, and the implementation of these curriculum by specially trained staff in appropriate environments". Article 3 of the Decree Law No. 573 of the MoNE (1997) defines special education as "education carried out by specially trained personnel in environments appropriate to the disabilities and characteristics of individuals with special educational needs through improved educational curriculum and methods to meet the educational needs of individuals with special educational needs". Within this framework, the educational process should be planned and structured in accordance with the individual characteristics of students. In particular, the role of the teacher in implementing education curriculum prepared for individuals with special needs is of great importance.

The characteristics and needs of individuals with special educational needs vary greatly. In the Regulation on Special Education Services in our country (MoNE, 2018), individuals with special needs are defined as various disabilities that occur in different areas. These disabilities are classified as mental (mild, moderate, severe, and very severe) disabilities, hearing and visual impairment, physical disabilities, language and communication learning disabilities, autism, chronic diseases, social adaptation difficulties, hyperactivity disorder, and gifted and talented individuals.

In special education, in line with the increasing and diversifying needs of individuals, according to the MoNE's 2018 Regulation on Special Education Services, many different people specialised in different disciplines are involved. These people include educational administrators, special education teachers, classroom teachers, counsellors, workplace coordinator teachers, workshop teachers, and master trainers.

A special education teacher can work with a group with a single disability or with a group with multiple disabilities (such as moderate-severe intellectual disability-CP and visually impaired-medium-severe intellectual disability), providing daily teaching plans and other related support to students with special needs, having quite different roles and responsibilities (Diken, 2014).

The roles expected from the teacher in special education are shown in Figure 1.

Figure 1. *Roles Expected from Teachers in Special Education*

The roles expected of teachers in special education include maximum effort to serve the individual needs of the students in the most appropriate way, be able to evaluate the academic strengths and weaknesses of the students, guide, plan compliance meetings in cooperation with experts from different disciplines (e.g. psychologists and, physicians), create Individualised Education Programmes (IEP), provide basic life skills training (daily living skills and, self-care skills), recognise the abilities of special education students, and work in cooperation with other specialists (psychologists and physicians,) and other branch teachers. It is also vital to have knowledge of current laws and legislation related to special education (Cavkaytar, 2018). In addition to providing the necessary education to children, becoming a special education teacher requires a wide range of qualifications to cover areas such as family education and leisure time activities in case of a lack of specialised staff in the school (Özsoy, Özyürek & Eripek, 2002). According to Erol and Merze (2023), although the number of paid teachers cannot be reached clearly, it is stated that approximately 100 thousand paid teachers work in schools affiliated with the MoNE during the academic year. In special education schools, this need is met with paid teachers due to the lack of special education teachers who are graduates of the field (Arslan & Aslan, 2014; Özyürek, 2008; Yılmaz & Üredi, 2018). Individuals who graduated from different professional fields complete the 80-hour special education awareness course prepared by the MoNE General Directorate of Lifelong Learning (2016) to work as a paid teacher in special education schools.

Today's rapidly changing science and technological developments reveal that the professional knowledge and skills of employees may be insufficient to adapt to this change. When a lifelong learning approach is adopted, professional skills need to be continuously developed at individual, professional, and social levels (Özdemir, 2021). In this context, in-service trainings stand out as the most effective practice.

One of the sectors where in-service training is most needed is the education sector due to factors such as having a lot of staff and experiencing rapid changes in the education and training process and insufficiency of pre-service training (Baykan & Oktay, 2016). The teaching profession is one of the areas where there is a need for in-service training due to the inadequacy of the training before starting the profession or because teaching is a lifelong profession (Aktan

& Budak, 2021; Bümen, Ateş, Çakar, Ünal & Acar, 2012; Üçler & Yıkılmış, 2021). Therefore, in the training of qualified staff , education is at the forefront, and one of the crucial components of the continuity of education is In-Service Training (IST) activities.

The reasons that make IST compulsory are the deficiencies and inadequacies arising from pre-service training, the necessity to adapt to the continuous change and development of the service, the need for individual development and progress in the job, and the necessity to acquire some knowledge, skills, and habits on duty (Karip, 2007). In order to meet both mandatory requirements and achieve superior work outputs, each institution should organise regular training programmes in accordance with its own internal dynamics and plan trainings specific to its needs.

In special education schools, the number of special education teachers and branch teachers is high, and according to the studies (Bümen et al., 2012; Karasu, Çığıl & Yılmaz, 2014), teachers generally focus on behaviour modification, classroom management, and teaching methods. In addition, according to the experience of the teachers, those who graduated between 2000-2008 focused more on teaching methods, while those who graduated in 2009 and later focused more on behaviour modification, classroom management, and teaching methods. The fact that teachers who graduated before 2000 did not take special education courses during their undergraduate education and the insufficient number of faculty members and staff trained in special education in universities reveal the need to support special education teachers. (Çıkılı, Gönen, Aslan Bağcı, & Kaynar, 2020; Kılıç, 2020; Tabak, 2021) emphasised in their studies that special education teachers graduated from different fields and did not receive education in special education, that efforts should be made to understand and eliminate the obstacles that they lack knowledge about student characteristics and needs for the education of students with special needs, and that in-service training should be organised for teacher needs. In addition, Şahin (2013) emphasised that special education in-service trainings and seminars should be increased, and their contents should be carefully planned to meet the needs of teachers working in special education schools. In this context, supporting special education teachers and branch teachers working in special education schools and organising in-service trainings is an important step in solving the problems in special education.

In this context, no study on thematic analysis of theses and articles on the in-service training needs of teachers in line with special education fields has been found, and it is expected that this study will provide comprehensive information to researchers who will work with teachers and support future studies.

This study aims to examine the studies conducted in Turkey between 2008 and 2022 on the in-service training needs of special education teachers, professional competence and self-efficacy, determination of needs, problems experienced by teachers in training for special education students, determination of in-service training needs and teachers' opinions. By examining postgraduate theses and national articles in detail according to the subject headings, it is aimed to reveal the subject trends and to provide a perspective for future research by determining the general profile of the studies. In line with these aims, answers to the following questions were sought.

In line with the in-service training needs of special education teachers, according to the examined theses and articles;

1. How is the distribution according to years?
2. How is the distribution according to type?

3. How is the distribution according to universities?
4. How is their distribution according to journals?
5. How is their distribution according to methods?
6. How is their distribution according to designs/models?
7. How is their distribution according to sample size?
8. How is the distribution according to data collection tools?
9. How is the distribution according to data analyses?
10. How is the distribution of topics?
11. How is the distribution according to suggestions?
12. How is their distribution according to keywords?

2. Method

In the method section of the research, detailed explanations about the research model, data collection tool, and the analysis process of the data obtained are given.

2.1. Research Model

In the research, document analysis technique, one of the qualitative research techniques, was preferred. Document analysis involves the examination of written materials that provide information about research-oriented facts and events, diversify the necessary data, and significantly increase the validity of the research (Yıldırım & Şimşek, 2021). In this study, national theses and articles on in-service training needs in special education between 2008 and 2022 were examined according to year, type, university, journal, method, design/model, sampling, data collection, data analysis, subject, recommendations of the studies, and keywords, and the findings were tried to be presented.

2.2. Data Collection Tool

As a data collection tool, the National Thesis Centre, Dergi Park, and Google Scholar databases within the study were scanned and examined. As a result of this search, 99 theses and 56 articles published between 2008 and 2022 were identified. The theses and articles were classified according to year, level, title, method, sample size, data collection method, design/model, university and journal, recommendations according to the findings of the studies, data analysis method, and keywords. The data obtained from these theses and articles were analysed and tabulated using descriptive statistics and number/percentage values, and graphs were created and interpreted.

2.3. Analysing the Data

Content analysis was used in the qualitative research method for data collection. The main purpose of content analysis is to organise the collected data in a way that the reader can understand by grouping them around certain themes using coding in accordance with certain rules, and it is a technique in which inferences are made as a result of defining certain features with an objective and systematic approach (Büyüköztürk, Kılıç Çakmak, Akgün, Karadenizli & Demirel, 2022).

In this context, 1247 theses and 86 articles were accessed with the keywords "special education", "individuals with special needs", "in-service training in special education", "training needs", "teacher opinions", "professional competence/self-efficacy", and "problems they experience" in the National Thesis Centre, Google Academy, and Dergi Park pages. Theses and articles between 2008 and 2022 in line with the in-service training needs of special education

teachers, as well as 1202 theses and articles, were excluded from the research subject when analysed in terms of the in-service training needs of special education teachers. Accordingly, 99 theses and 56 articles were analysed. Firstly, nine general titles were determined according to the subject headings of the analysed theses and articles. In addition, theses and articles suitable for the sub-objectives of the research were classified separately according to year, type, university and journal, method, design/model, sample size, data collection, data analysis, subject, suggestions according to the findings of the studies, and keywords. After the classification process was completed, the collected data were defined and then expressed in numbers and percentages, visualised through graphs, analysed, and interpreted.

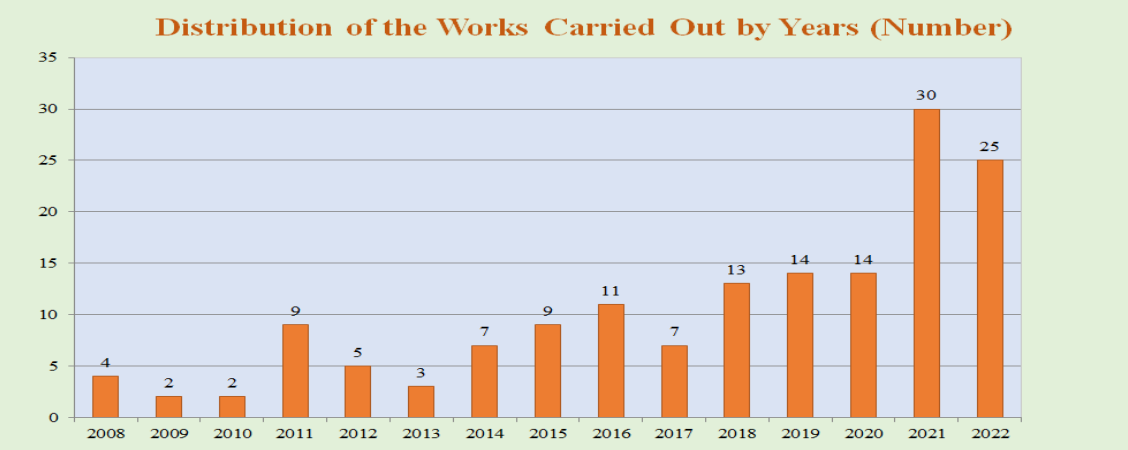
2.4. Ethics

Ethical rules have been followed in this research. Since the study is a document review study and a systematic literature review, it is not included in the group of studies that require Ethics Committee Permission. Therefore, Ethics Committee Permission was not declared.

3. Findings

3. 1. Findings and Interpretation Related to the First Sub-Problem

The data collected for the sub-problem "How is the distribution of articles and theses on special education teachers according to years in line with their in-service training needs?" are shown in Graph 1.



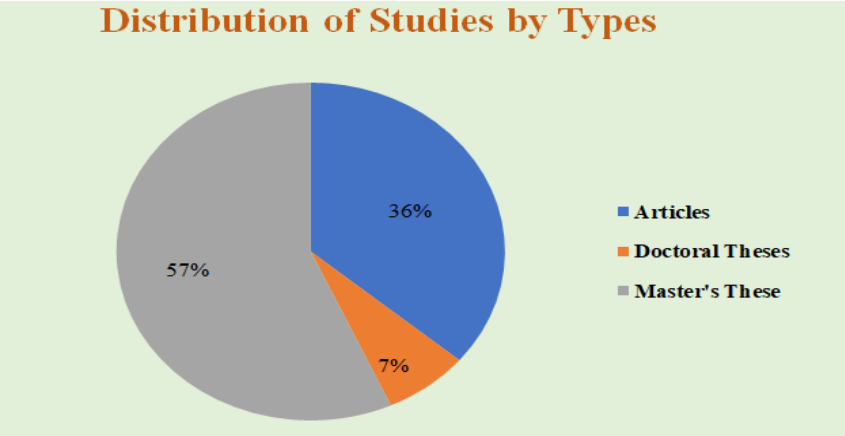
Graph 1. *Distribution of the Studies by Years*

Graph 1, which includes the distribution of theses and articles related to the field according to years, shows a change according to years. In 2009 and 2010 (2), 2013 (3), 2008 (4), 2012 (5), 2014 and 2017 (7), 2011 and 2015 (9), 2016 (11), 2018 (13), 2019 and 2020 (14), 2022 (25), and 2021 (30) studies were conducted. It was observed that most studies in this field were conducted in 2021 and 2022.

3.2. Findings and Interpretation Related to the Second Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles on special education teachers according to their in-service training needs?" are shown in Graph 2. In this

regard, it is noteworthy that in recent years, there has been an increase in studies on the in-service training needs of special education teachers.

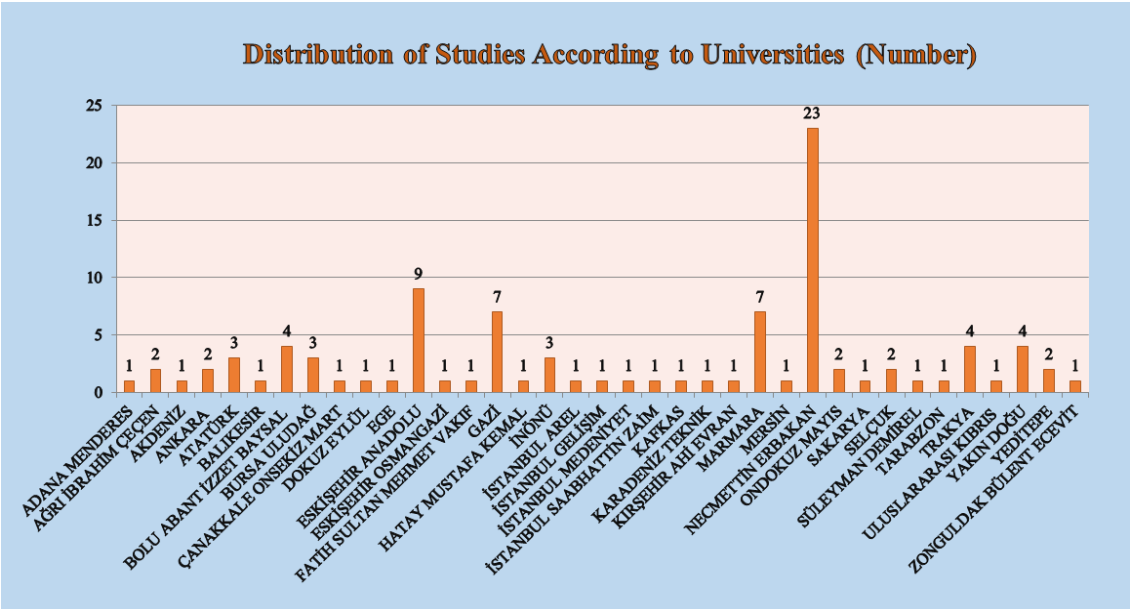


Graph 2. *Distribution of Studies According to Types*

When Graph 2, which includes the data according to the types of studies on in-service training needs of special education teachers, is examined, it is seen that 7% of them are doctoral theses; 36% are articles; 57% are master's theses. It is seen that there are mostly master's theses and articles in the field of in-service training needs of teachers and the least number of doctoral thesis studies.

3.3. Findings and Interpretation Related to the Third Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles on special education teachers according to universities in line with their in-service training needs?" are shown in Graph 3.

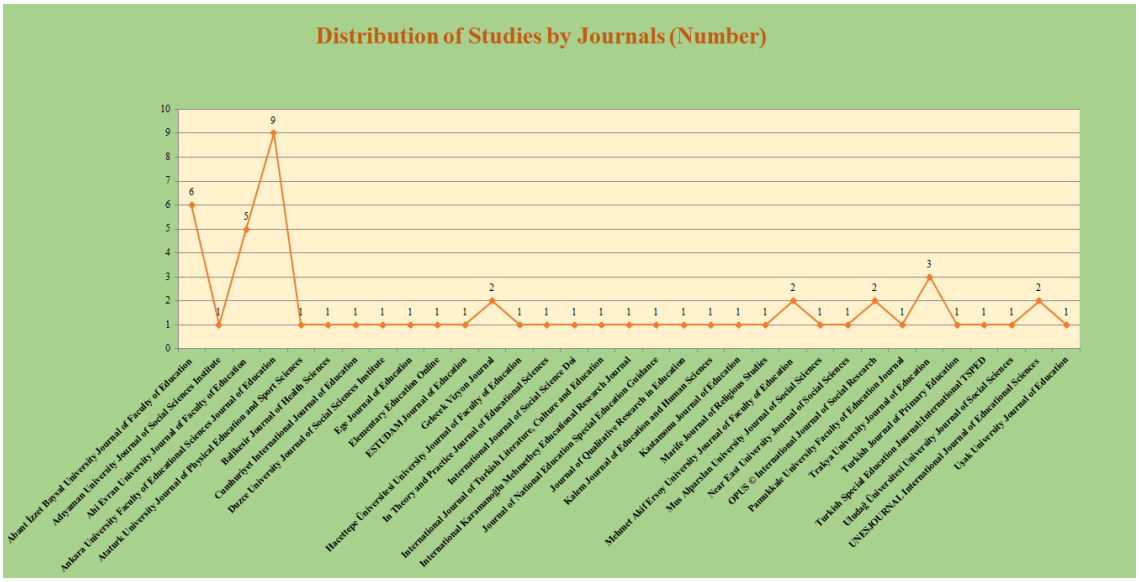


Graph 3. *Distribution of Studies According to Universities*

When Graph 3, which includes the data according to the university distribution of the studies on in-service training needs of special education teachers, is analysed, it is seen that Necmettin Erbakan University (23) has the majority of the distribution. Necmettin Erbakan University is followed by Anadolu University (9), Gazi University and Marmara University (7), Bolu İzzet Baysal University, Trakya University and Near East University (4), Atatürk University, Bursa Uludağ University, and İnönü University (3), Ağrı İbrahim Çeçen University, Ankara University, Ondokuz Mayıs University, Selçuk University and Yeditepe University (2), and other universities (1).

3.4. Findings and Interpretation Related to the Fourth Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles on special education teachers according to the journals in line with their in-service training needs?" are shown in Graph 4.

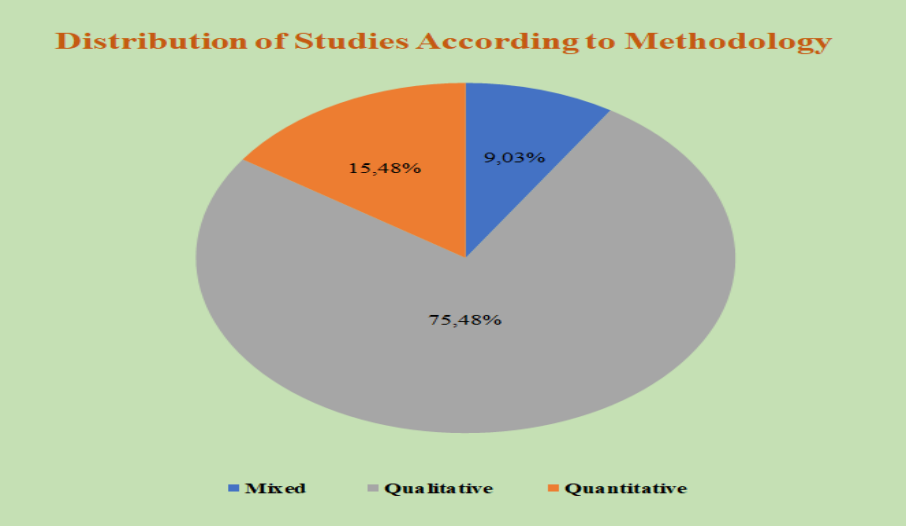


Graph 4. *Distribution of Studies According to Journals*

Graph 4, which includes the data according to the journal distribution of the studies on in-service training needs of special education teachers, is analysed, it is seen that Ankara University Faculty of Educational Sciences Journal of Special Education (9) has the majority of the distribution. Ankara University Faculty of Educational Sciences Journal of Special Education is followed by Bolu Abant İzzet Baysal University Journal of Faculty of Education (6), Ahi Evran Üniversitesi Sosyal Bilimler Enstitüsü Dergisi (5), Trakya Journal of Education (3), Future Visions Journal, Mehmet Akif Ersoy University Journal of Education Faculty, OPUS Journal of Society Research, The Journal of International Educational Sciences (2), and other journals (1).

3.5. Findings and Interpretation Related to the Fifth Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles on special education teachers according to their methods in line with their in-service training needs?" are shown in Graphic 5.

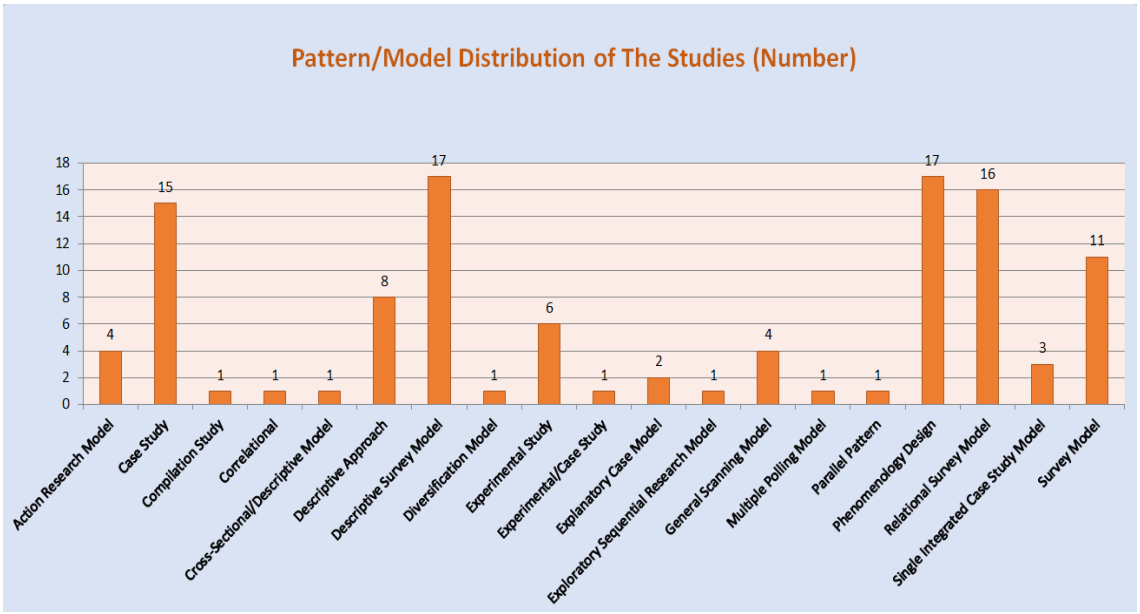


Graph 5. *Distribution of Studies According to Methods*

According to the methods of the studies, the distribution of the studies on in-service training needs of special education teachers in Graphic 5 shows that 9,03% used the mixed method; 15,48% used the quantitative method; 75,48% used the qualitative method, and the qualitative method was used most. Qualitative methods focus on examining a specific field in-depth and require the development of a unique research design and data analysis strategy for each research problem, as there are no specific rules and standard approaches in qualitative methods (Yıldırım & Şimşek, 2021). Therefore, qualitative research has its own unique characteristics.

3.6. Findings and Interpretation Related to the Sixth Sub-Problem

The data collected for the sub-problem "How is the distribution of special education teachers according to their pattern/model distribution in line with their in-service training needs?" are shown in Graph 6.

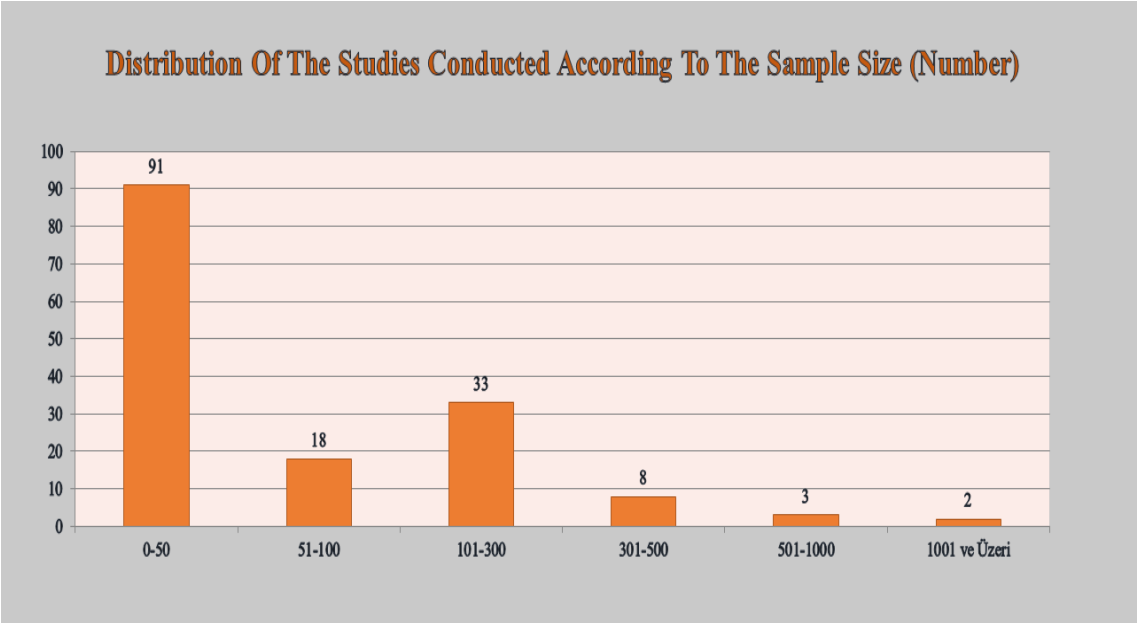


Graph 6. *Distribution of Studies According to Pattern/Model Distribution*

When the distribution of the studies on in-service training needs of special education teachers in Graph 6 is analysed according to their methods, it is seen that 20 different designs/models were used. Looking at Graph 6, it is seen that the most commonly used design/model is the interview technique model (37), phenomenology design and descriptive screening model (17), relational survey model (16), case study (15), and survey model (11).

3.7. Findings and Interpretation Related to the Seventh Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles on special education teachers according to the sample size in line with their in-service training needs?" are shown in Graph 7.

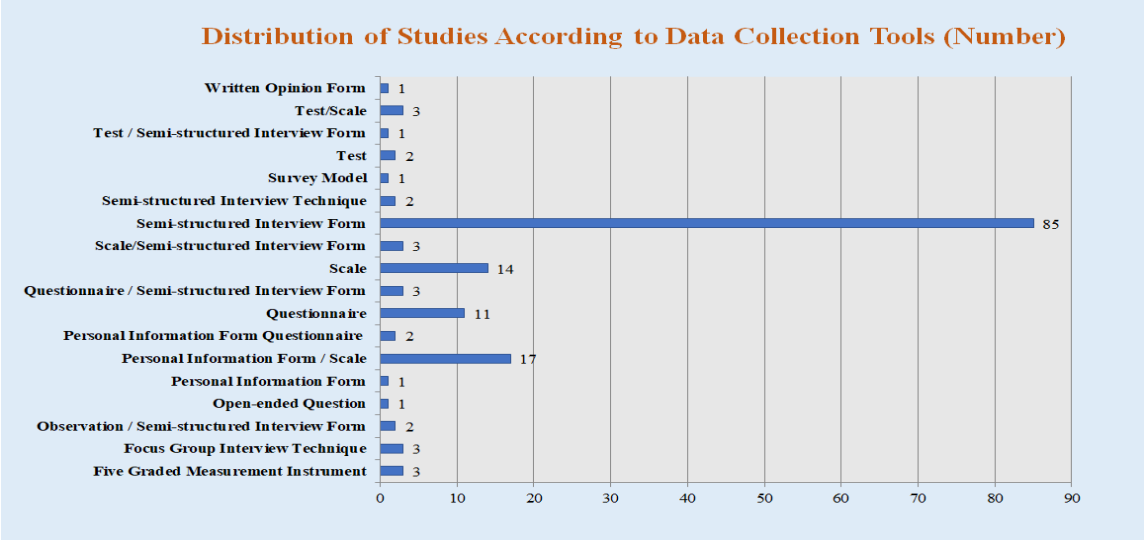


Graph 7. *Distribution of Studies According to The Sample Size*

When the distribution of the data obtained in Graph 7 according to the sample size of the studies on in-service training needs of special education teachers is examined, it is seen that the majority is between 0-50 (91), followed by 101-300 (33), 51-100 (18), and 301-500 (8) sample groups. However, it is noteworthy that the number of theses with a sample size of 501-1000 (3) and 1001 and above (2) is quite limited.

3.8. Findings and Interpretation Related to the Eighth Sub-Problem

The data collected for the sub-problem "How is the distribution of special education teachers according to their in-service training needs?" are shown in Graph 8.

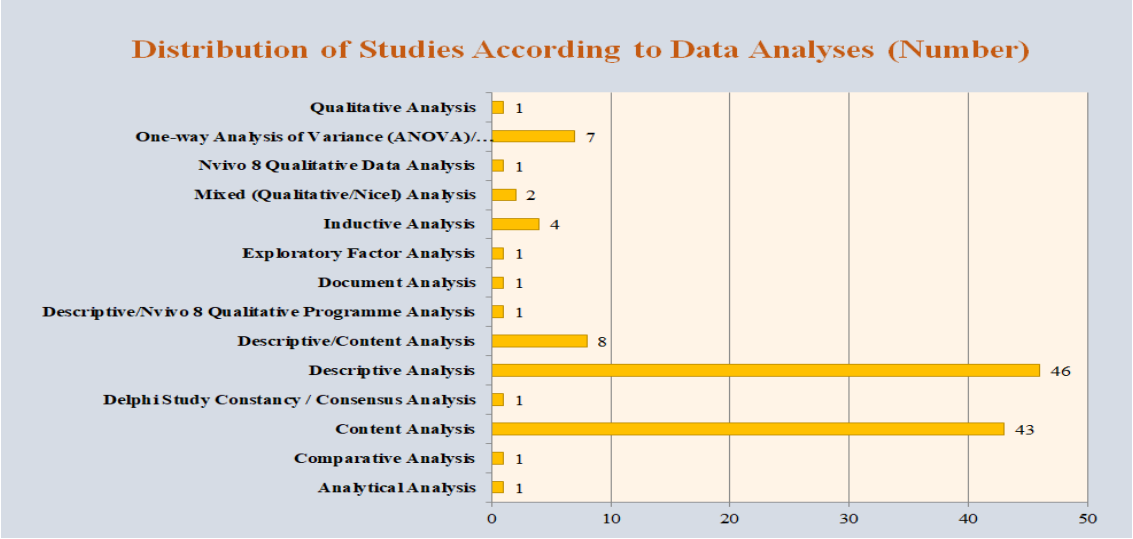


Graph 8. *Distribution of Studies According to Data Collection Distribution*

When the distribution of the studies on in-service training needs of special education teachers in Graph 8 is analysed according to the methods, it is seen that 20 different data collection tools were used. Looking at Graph 8, it is seen that the most commonly used semi-structured interview form (85) and compared to other data collection tools, the semi-structured interview form is more commonly preferred.

3.9. Findings and Interpretation Related to the Ninth Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles on special education teachers according to data analyses in line with their in-service training needs?" are shown in Graph 9.



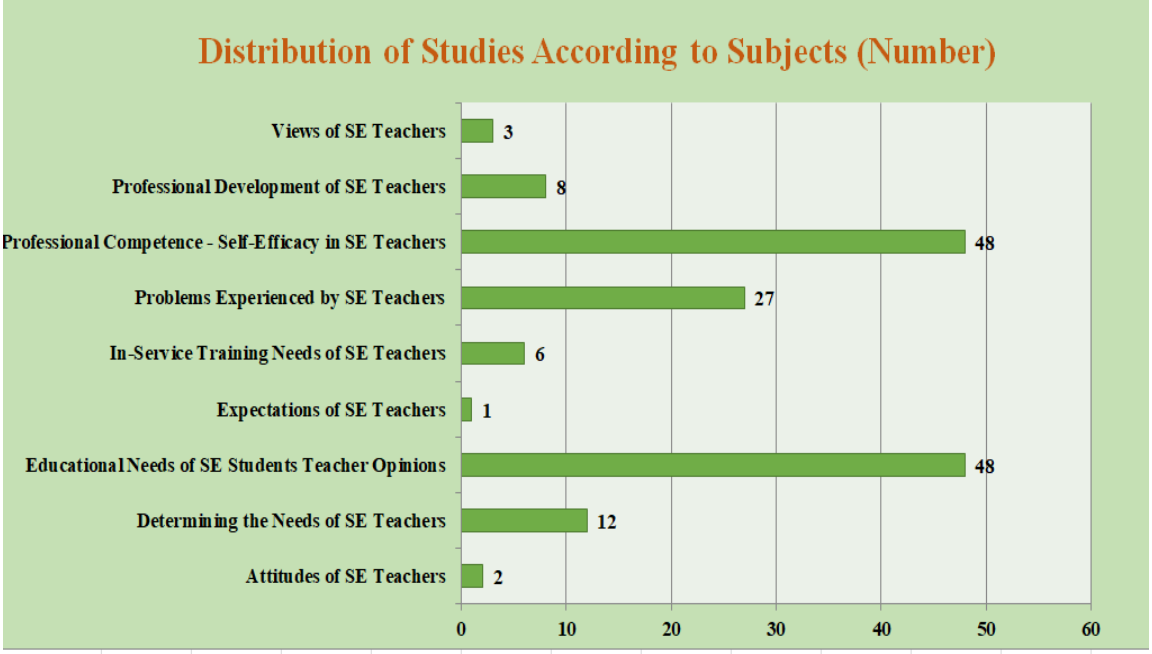
Graph 9. *Distribution of Studies According to Data Analyses*

When the distribution of the studies conducted in line with the in-service training needs of special education teachers in Graph 9 is examined according to their methods, it is seen that

they were analysed in the context of 15 different data analyses. Looking at Graph 9, it is seen that the most commonly used data analysis methods are descriptive analysis (46) and content analysis (43) analysis methods, and they are used to a greater extent than other data analysis methods.

3.10. Findings and Interpretation Related to the Tenth Sub-Problem

The data collected for the sub-problem "How is the distribution of the studies on in-service training needs of special education teachers according to their subject distribution?" are shown in Graph 10.



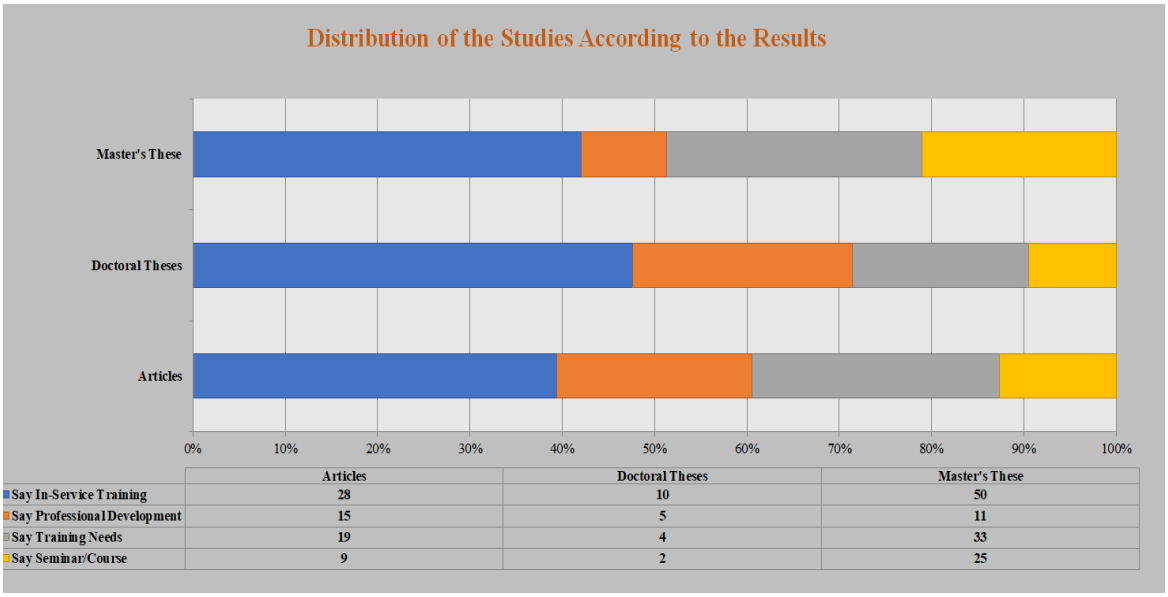
Graph 10. *Distribution of Studies According to Subject Distribution*

In Graph 10, the subject distributions of the studies conducted in line with the in-service training needs of special education teachers are grouped under nine titles. When the distribution according to the data obtained in Graph 10 is analysed, it is seen that the studies under the title of "Professional Competence-Self-Competence of Special Education Teachers (48) and Teacher Opinions on Special Education Students' Education (48)" are in the majority.

Twenty seven studies were conducted under the title of 'Problems Experienced by Special Education Teachers'. This is followed by 'Determining the Needs of Special Education Teachers (12)', 'Professional Development of Special Education Teachers' (8), 'In-Service Training Needs of Special Education Teachers' (6), 'Opinions of Special Education Teachers' (3), 'Attitudes of Special Education Teachers' (2), and 'Expectations of Special Education Teachers' (1).

3.11. Findings and Interpretation Related to the Eleventh Sub-Problem

The data collected for the sub-problem "How is the distribution of the theses and articles related to the findings according to the results in line with the in-service training needs of special education teachers?" are shown in Graph 11.



	Articles	Doctoral Theses	Master's These
Say In-Service Training	28	10	50
Say Professional Development	15	5	11
Say Training Needs	19	4	33
Say Seminar/Course	9	2	25

Graph 11. *Distribution of the Findings of the Study According to the Results*

When the distribution of the data in Graph 11 according to the suggestions of the studies carried out in line with the in-service training needs of special education teachers is analysed, it is seen that most of them need "In-Service Training" (88). "Training Needs" (56), "Seminar/Course" (36), and "Professional Development" (31) needs and suggestions were made.

3.12. Findings and Interpretation Related to the Twelfth Sub-Problem

The data collected for the sub-problem "How is the distribution of theses and articles about special education teachers according to keywords in line with their in-service training needs?" are shown in Figure 2.

Figure 2. *Distribution of the Study According to Key Words*

According to the word cloud in Figure 2, it is seen that in most of the studies, words such as special education, individual with special needs, special education teacher, IEP (Individualised Education Programme), inclusion, autism, individual with mental disabilities, in-service training, educational need, education, professional competence, professional development, self-efficacy, educational problems, teacher opinions, candidate teacher, mentor teacher, administrators, music education, visual arts education, cooperation, and qualitative study, were used intensively.

4. Discussion and Conclusion

In this study, 99 postgraduate theses and 56 articles conducted between 2008 and 2022 regarding the studies conducted in line with the in-service training needs of special education teachers, research years, types of research, universities, journals, methods, design/model used, sample size, data collection tools, data analysis, subject distributions, recommendations of the studies according to the findings and keywords were examined. The data were analysed by document analysis, one of the qualitative research methods, and analysed by content analysis method.

As a result of the research, when the distribution of the studies conducted in line with the in-service training needs of special education teachers according to years was examined, a total of 99 postgraduate theses and 56 articles were examined, and it was seen that the most studies were conducted in 2021 and 2022. In this context, the increase in the importance of special education in recent years is striking. In the 2023 vision document of the Ministry of National Education published in 2018, under special education, strengthening the justice-based approach was emphasised. This approach prioritises protecting the rights of students with mental or physical disadvantages. At the same time, it is emphasised that for the success of the reforms to be made in special education in Turkey, problems should be correctly identified, and effective solution strategies should be developed. Studies carried out in recent years support the increasing efforts made in special education and the results obtained.

When the distribution of the studies conducted in line with the in-service training needs of special education teachers was examined according to their types, it was seen that 57% were master's theses,; 36% were articles, and 7% were doctoral theses. These findings suggest that the studies conducted in our country in line with the in-service training needs of special education teachers are mostly master's theses, followed by articles, and least doctoral theses. According to the statistical information published by the higher education institution in our country, the number of master's programmes is higher than the number of doctoral programmes, and the highest number of thesis studies between 2008 and 2022 were carried out in 2021 and 2022, respectively (Higher Education Board HEB, 2023). In addition, according to the 2023 higher education information management system (2023) statistical results, the number of students enrolled in master's programs is significantly higher than the number of students enrolled in doctoral programs. Ayvacı and Altınok, (2019); Başaran et al., (2021); Coşkun, Dündar, and Parlak (2014) stated in their studies that the difficulty of admission requirements for doctoral education and the fact that the doctoral process is more laborious in terms of financial, time and psychological aspects compared to master's degree might be effective in the number of doctoral theses being less than master's theses. In addition, the lack of doctoral programs in special education programs in every university may have been effective in the lack of studies on the in-service training needs of special education teachers. These data seem to confirm the findings of our own research.

It is the opinion that the postgraduate thesis studies conducted in line with the in-service training needs of the special education teachers examined in this research were conducted by Necmettin Erbakan University (23), followed by Gazi University (9), Anadolu University and Marmara University (7), and other universities conducted four or less than four studies. It can be said that most of the studies conducted in this context were conducted at Necmettin Erbakan University. Coşkun, Dündar, and Parlak (2014); Erol and İlhan-Ildız (2020); Gölünay, Çalımlı, and Karakelle (2022); Kaya et al. (2022); Sönmez and Özcan (2020) reached the findings that Gazi University, Anadolu University, Marmara University, and Necmettin Erbakan University were the most common universities in terms of the distribution of postgraduate studies on special education and in-service training needs. In this context, the studies conducted in the literature support this study.

When the distribution of the studies conducted in line with the in-service training needs of special education teachers according to the journals is analysed, it is seen that Ankara University Faculty of Educational Sciences Journal of Special Education (9), followed by Bolu Abant İzzet Baysal University Journal of Faculty of Education (6) and Ahi Evran Üniversitesi Sosyal Bilimler Enstitüsü Dergisi (6), other journals published three or less than three articles. The Department of Special Education, which was established in 1965 within the Faculty of Educational Sciences of Ankara University to train the expert staff needed in the field of special education, was transformed into a department under the Department of Psychological Services in Education with a new regulation made in 1981, and then continued to serve as Education of the Mentally Handicapped, Education of the Hearing Impaired and Education of Maladaptive Children with the decision of the Council of Higher Education since 1995. Today, the Department of Education of the Mentally Handicapped trains teachers in mental disabilities at the undergraduate level (Ankara University, 2023). In this context, when the historical development process of Ankara University Faculty of Educational Sciences, Department of Special Education (2024), and the objectives of Ankara University Faculty of Educational Sciences Journal of Special Education which is one of the scientific publishing organs established for the development of the field of special education and the publication of scientific information, and the distribution of the studies conducted in line with the in-service training needs of special education teachers according to the journals in which they are published are examined, the fact that the researchers of Ankara University Faculty of Educational Sciences Journal of Special Education show more tendency confirms the finding we obtained as a result of the research.

Another finding of the study is that when the distribution of the studies conducted in line with the in-service training needs of special education teachers is analysed according to the methods, it is seen that the qualitative method is used at a rate of 75%. Qualitative research aims to explain a phenomenon in depth and its own context (Yıldırım, 1999). These studies investigate why people behave in certain ways in the face of events and phenomena, the reasons behind their attitudes and behaviors, how individuals and societies are affected by their environment, how and why cultures are formed and developed, and how social groups communicate (Tekindal & Arsu, 2020). According to Kaya et al. (2022), in-service training includes activities organized to improve teachers' professional competencies and skills and to support their career development. The roles expected of teachers in educating individuals with special needs require research in unique and ever-changing environments. Therefore, it can be justified that more qualitative research is conducted to determine the in-service training needs of special education teachers and conduct in-depth studies.

The other finding of the study was that the interview technique was used the most when analyzed according to the pattern/model distribution in line with the in-service training needs of special education teachers, followed by phenomenology design and descriptive screening

model, relational screening model, case model and survey model, and that this pattern/model was mostly used. It is stated in the literature that there is no single definition of qualitative research method. Qualitative research method is used as a broad umbrella concept and includes a number of sub-concepts that are closely related to various disciplines. Qualitative research encompasses many different concepts such as "case research", "interpretive research", "descriptive research", "action research", and "content analysis". In addition, this approach includes techniques such as observation, interview and document analysis, which are carried out through qualitative data methods, thus enabling perceptions and events to be handled more realistically. In other words, this method emphasizes the process of investigating and understanding social phenomena within their environment and context (Yıldırım & Şimşek, 2021).

Another finding of the research is that when the distribution of special education teachers according to the sample size in line with their in-service training needs is examined, it is seen that the majority (91) is between 0-50. Very few studies have sample sizes between 501-100 and 1000 and above. In line with the high use of the semi-structured interview technique, the sample size of the data may be between 0-50. The semi-structured interview technique is an approach that offers flexibility for the interviewer to have the opportunity to ask predetermined questions and, at the same time, to learn more in-depth information about the subject in this process. This flexibility allows the interviewer to open up the topic further with additional questions. In addition, this method gives the interviewer flexibility in terms of time, and the interviewer can keep the sample size under control while dealing with each participant individually. According to the research findings, the maximum sample size was kept between 0-50, which can be shown as a justification for this situation.

It can be said that the fact that the majority of the studies on the subject are qualitative methods has an impact on the ways of data collection. Qualitative methods focus on examining a specific field in depth (Yıldırım & Şimşek, 2021). This type of research investigates why people behave the way they do in the face of events and phenomena, the reasons behind attitudes and behaviors, how individuals and societies are affected by each other and their environment, how and why cultures are formed and developed, and how social groups communicate by addressing social aspects (Baltacı, 2019). It can be said that the qualitative research method, design/model, and data collection techniques were effective in determining the qualitative research method, design/model, and data collection techniques because the entire study consisted of adults and the data obtained were examined in line with the in-service training needs of special education teachers trying to make sense of the events in their own environment and various social skills, communicating with people, collecting detailed data in the form of notes, figures, tables, pictures of data collection methods and conducting the process naturally without trying to change the environment.

In the study, when the in-service training needs of special education teachers were examined according to the distribution of topics, it was gathered under nine main headings, and it was concluded that most of the studies were conducted on the professional competence-self-efficacy of special education teachers, teacher opinions on the educational needs of special education students, and the problems experienced by special education teachers. However, very few studies have been conducted on the in-service training needs of special education teachers. Erol and Merze (2023); Karasu et al., (2014), stated that the fact that teachers who graduated before 2000 did not take special education courses during their undergraduate education, the low number of faculty members and staff trained in the field of special education in universities, and the fact that the courses on special education are given by faculty members who are not trained in this field are stated as a necessity to support special education teachers. In addition,

classroom teachers and branch teachers work in special education schools and are limited according to the need. In this context, the Ministry of National Education organizes short-term special education certificates and meets the necessary needs of out-of-field graduates who have received pedagogical formation. Therefore, the majority of teachers working in special education schools are out-of-field graduates and participated in the course program. As a result of the research, it can be shown as a justification that most thesis studies were conducted on professional competence and self-efficacy and the problems experienced by special education teachers.

Another finding of the research is that when the distribution of the findings according to the suggestions in line with the in-service needs of special education teachers is examined, all studies were grouped under four main headings, and 100% made at least one suggestion under this heading. According to the findings of the research, it is seen that the majority of special education teachers need in-service training; one-third of them need training, followed by professional development and courses/seminars for teachers. The need for special education teachers was met by classroom teachers in special education schools until 1983, and the majority of these teachers were trained through special education course programs and in-service training, the opening of the special education teaching program at Anadolu University Faculty of Education and its first graduates in the 1986-1987 academic year, the opening of special education departments in universities after 1990, the efforts to train special education teachers continued with the opening of new departments, and many legal processes supporting these efforts began (Akçamete & Kargın, 1996). Today, 15% of the world's population is made up of people with disabilities. In Turkey, it is thought that 39 thousand people work in early childhood, primary and secondary education, higher education, non-formal education, special education, and rehabilitation centers within the scope of special education services regulation. In the studies of Erol and Merze, (2023); Gönüldaş and Gümüşkaya, (2022); Sarı, Atbaşı and Çitil, (2017); Sivrikaya and Yıkılmış, (2016), the majority of the need for teachers who provide education in special education institutions in the Ministry of National Education is met with out-of-field graduates and the maximum level of competencies expected from special education teachers is a field that requires expertise in many areas such as family education and guidance. apart from skills such as teaching method techniques or classroom management. In this direction, as a result of the findings, it is vital to suggest training needs such as professional development, in-service training needs, training needs, and courses/seminars for teachers in special education.

According to the findings of the study, when examined according to the keywords in line with the needs of special education teachers, the words special education, in-service training, educational need, candidate teacher, IEP (Individualized Education Program), professional competence/self-efficacy, individual with special needs, special education teacher, mainstreaming, autism, mentally disabled individual, educational problems, teacher opinions, guidance teacher, administrators, music education, visual arts education, and cooperation were used predominantly. The intensity of many different keywords, as a result of the increasing and differentiating needs of individual characteristics in special education, Cavkaytar (2018) and Özsoy et al. (2002) stated that many disciplines, such as educational administrators, special education teachers, counselors, workplace coordinator teachers, workshop teachers, and master instructor, should be together in special education, where many staff with different areas of expertise are involved according to the Special Education Services Regulation (MoNE, 2018).

As a result, it was seen that qualitative research methods and semi-structured interview forms were used intensively in line with the needs of individuals with special needs and special education teachers. In this context, quantitative and mixed-design research methods can be conducted. Data collection tools can be developed to examine in-depth the in-service training

needs of special education teachers and reveal the needs of teachers on their needs and to be applied. In-service training needs of all special education, classroom, and branch teachers working in special education can be determined, and more studies can be conducted in this field. In the study conducted by Doğrul, Gülle, and Akay (2022), it was concluded that teachers in Turkey focus on various in-service training needs, such as professional needs, in-service training programs, and technology-based needs. Yıldırım, Ünsal, and Tolunay (2015) concluded that rapid developments in science and technology cause great changes in social, economic, and cultural areas. To adapt to these changes, individuals need lifelong education because the education received in schools alone is insufficient. Şahin and Güler Kardeniz (2023) emphasized the need for new research on in-service needs that will contribute to the literature to increase education success and ensure continuous professional development of teachers. As a result of the findings of the theses and articles conducted in line with the in-service training needs of special education teachers, according to their suggestions, most of them suggest that there is a need for in-service training. There are suggestions for training needs, professional development, and seminar/course training, and if at least one of the suggestions of each study is recommended, studies can be conducted intensively in line with the in-service training needs of special education teachers.

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Ethics Committee Permission:

Ethical rules have been followed in this research. Since the study is a document review study and a systematic literature review, it is not included in the group of studies that require Ethics Committee Permission. Therefore, Ethics Committee Permission was not declared.

Research Article

Asian Journal of Instruction
Asya Öğretim Dergisi

2024, 12(2), 59-78

dergipark.gov.tr/aji
ISSN:2148-2659

Recieved: 01/10/2024 Accepted: 10/12/2024 Published: 31/12/2024

Teacher Autonomy from the Perspective of Middle School Teachers

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Doğuş, F., & Tabak, S. (2024). Teacher autonomy from the perspective of middle school teachers. *Asian Journal of Instruction, 12*(2), 59-78. Doi: 10.47215/aji.1559266

Abstract

This study aims to examine middle school teachers' perceptions of teacher autonomy in depth. The study was conducted using a phenomenological design, a qualitative research method. The study participants were 17 middle school teachers working in public schools in three provinces located in northern Turkey. Data were obtained through semi-structured interviews. The results showed that teachers defined the concept of autonomy in the context of autonomy in the educational process, professional development, professional respectability, and freedom of expression. Teachers emphasized that autonomous teachers have characteristics such as pedagogical freedom and creativity, using technology, student orientation, critical and analytical thinking, independence and self-confidence, content knowledge and research ability, social and communication skills, leadership, and problem-solving. Finally, the factors affecting teachers' autonomy were analyzed. In this context, it was concluded that social and environmental factors, personal and professional characteristics, and institutional and system factors are among the factors that affect teacher autonomy.

Keywords: Factors affecting teacher autonomy, middle school teachers, teacher autonomy

1. Introduction

Learner-centered practices and the educational emphasis of student-centered learning and teaching theories have transformed the roles of teachers within the classroom environment. Student-centered practices, which prioritize providing opportunities for students to assume responsibility for their own learning and regulate this process, have necessitated a reorientation of teachers' classroom roles and augmented their responsibilities in this regard. Educators may encounter difficulties in adapting to this shift in classroom roles. Teachers' capacity to address such challenges is significantly contingent on teacher autonomy (Huang, 2005).

Pearson and Hall (1993) conceptualized teacher autonomy as teachers' perceptions of whether they control themselves and their work environments. Little (1995) defined teacher autonomy as a teacher's capacity to undertake self-directed professional action. This definition encompasses teachers possessing a robust sense of personal responsibility for their teaching through continuous reflection and analysis as well as cognitive and affective control of teaching. Smith (2000) characterizes an autonomous teacher as one who performs their duties and maintains a consistent openness to professional development, emphasizing that teacher autonomy is more closely

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associated with professional growth. If teacher autonomy is considered the authority to implement their own choices and decisions regarding teaching and learning activities in the classroom, it can be posited that autonomy is, in fact, a phenomenon that emerges in relation to the general structure of the educational environment (Öztürk, 2011). According to an alternative perspective, teacher autonomy encompasses freedom pertaining to curricula, teaching methods and techniques, student discipline, achievement, measurement and evaluation of behaviors, planning of classroom and activity time, as well as professional development (LaCoe III, 2008). According to Ayral, Özdemir, Türedi, Fındık, Büyükgöze, Demirezen and Tahirbegi, (2014), teacher autonomy refers to the domain in which teachers possess authority in matters, such as determining and implementing the content of curricula utilized in schools, selecting courses and textbooks, determining teaching methods and materials, monitoring and evaluating the teaching process, and school management. However, teacher autonomy does not imply that teachers can act with an unrestricted freedom. In accordance with ethical, scientific, and pedagogical principles, teachers can be granted autonomy in curriculum, method, technique choices, classroom management, school management decisions, and personal professional development (Çolak et al., 2017). In this context, teachers possess limited power and authority in their work. What is perceived as autonomy by one teacher may be interpreted as isolation for another. While one educator may view autonomy as a means of attaining substantial freedom from interference or supervision, another may perceive it as liberty to perform tasks and develop collaborative relationships outside the classroom. While some teachers appreciate autonomy, others regard it as a means of evading principals' responsibilities (Frase & Sorenson, 1992).

Teacher autonomy plays a significant role in educational and training activities. The level of teacher autonomy can substantially influence the attainment of institutional objectives and the efficacy of instructional processes (Maviş Sevim et al., 2017). As teachers' autonomy increases, their responsibilities expand, their duties intensify, and professional development continues. This autonomy, granted to educators, exhibits a strong correlation with student achievement (Ertürk, 2020). As the scope of a teacher's autonomy expands, the independence of their decision making increases, consequently exerting a positive impact on student performance. Ayral et al. (2014) examined the relationship between teacher autonomy and PISA examination results and concluded that it enhanced student achievement. Teachers' autonomous behaviors in instructional activities encourage students to participate more actively in the learning process and positively influence their competence and socialization (Oğuz, 2013).

When teacher autonomy exists within an educational system, educators make decisions collaboratively with their colleagues, school administrators, and students in accordance with their professional expertise, assuming both the authority and responsibility for these decisions (Karatay et al., 2020). In addition to the assertion that teacher autonomy is crucial for the development of teacher professionalism, granting autonomy to teachers and empowering them is emphasized as an appropriate starting point for addressing current school challenges (Melenyzer, 1990; Short, 1994). From these perspectives, it is evident that numerous factors influence teacher autonomy. An examination of the international literature reveals that Pearson and Hall (1993) classify teacher autonomy into curriculum autonomy and general teaching autonomy. Friedman (1999) emphasized the dimensions of teacher autonomy such as planning and implementation of instruction, participation in management processes, and professional development. McGrath (2000) defined teacher autonomy as the educator's ability to operate independently from external control through self-directed activities and development. Another perspective considers the dimensions of teacher autonomy as instructional, managerial, financial, personal, and professional autonomy (Lai-ngok, 2004; Yoon & Thye, 2002).

According to Eurydice (2008), the dimensions of teacher autonomy are categorized as educational services, working time and professional tasks, continuous professional development and reform,

and participation in educational innovations. Strong (2012) emphasized the dimensions of teacher autonomy such as decision-making ability, freedom, and authority. An examination of the national literature on the dimensions of teacher autonomy reveals that these dimensions are emphasized in specific ways. Öztürk (2011) lists the sub-dimensions of teacher autonomy as the planning and implementation of instruction, participation in management processes, and professional development. Üzüm (2014) delineated the dimensions of teacher autonomy as structural dimension (political sense-participation in management processes), individual dimension (psychological sense-autonomous teacher and professional development), and technical dimension (technical sense-planning and implementation of instruction). Boz (2014) and Çelik (2016) identified the dimensions of teacher autonomy as instructional autonomy, administrative autonomy, financial autonomy, and personal and professional autonomy in their literature reviews. Ertürk (2020) posited that teacher autonomy should be examined by considering indicators such as making important decisions regarding education, participation in school management, development of professional competencies in teachers, and contributions to the planning and implementation of teaching.

In the national literature, the dimensions of teacher autonomy were comprehensively investigated by Çolak and Altınkurt (2017), who conducted a scale development study in this context. The scale aimed to determine the dimensions of teachers' autonomous behaviors. Within the scope of the scale, the dimensions of teacher autonomy were identified as teaching process autonomy, curriculum autonomy, professional development autonomy, and professional communication autonomy. Autonomy of the teaching process pertains to teaching lessons and classroom management. This autonomy encompasses the teaching methods and techniques employed by the teacher during the lesson, the teaching materials to be utilized in the lesson, the time to be allocated for activities in the lesson, the implementation of the measurement and evaluation process, communication in the lesson, and classroom organization (Pearson & Moomaw, 2005). Teachers manage the learning-teaching process and possess the authority to make and implement independent decisions (Çolak & Altınkurt, 2017).

Another sub-dimension, curriculum autonomy, is the autonomy area based on what, how, and when teachers will teach in accordance with the needs of students. Consequently, curricula should provide teachers with necessary flexibility. Curriculum autonomy is associated with teachers' active participation in the curriculum development process and input into the curriculum. Teachers should be able to demonstrate flexibility in updating the curriculum in alignment with the needs of students, changing conditions, and the aims of education and training, as well as utilizing teaching materials appropriate to these conditions (Çolak & Altınkurt, 2017). Professional development autonomy relates to teachers' abilities to act professionally in their work. Teachers should possess the ability to manage their own professional development. The capacity of teachers to attend necessary training in accordance with their needs, benefit from in-service training, and not be subject to the pressure of authority in these processes are considered within the scope of professional autonomy (Çolak & Altınkurt, 2017). Finally, professional communication autonomy refers to the ability of teachers to communicate with other teachers, educational administrators, and parents without apprehension or pressure. Teachers should be able to express their ideas freely and engage in independent thoughts (Çolak & Altınkurt 2017).

Various studies on teacher autonomy exist in the international and national literature. An examination of international research on this subject reveals a study on teacher autonomy in the context of the potential for freedom or control (Lawson, 2004), an investigation examining the relationship between teacher autonomy and stress, job satisfaction, empowerment and professionalism (Pearson & Moomaw, 2005), studies on student autonomy and teacher autonomy (La Ganza, 2008; Lamb, 2008; Smith et al, 2008), research focusing on different aspects of the need and importance of teacher autonomy and professional independence in the education system

(Sehrawat, 2014), an analysis on the role of teacher autonomy in the broader issue of teacher professionalism (Parker, 2015), a study on reflections on the role of teacher autonomy (Ramos, 2006), the first large-scale quantitative study in the UK to examine teacher autonomy and its importance for retention (Worth & Van den Brande, 2020), research that aimed to investigate the direct impact of distributed leadership on teacher job satisfaction and how distributed leadership indirectly affects teacher job satisfaction through teacher autonomy and teacher collaboration (Liu et al., 2021), a study of teacher autonomy in different models of educational management using qualitative data from research on teacher autonomy conducted in Norway and Brazil (Lennert Da Silva, 2022), an investigation into the relationship between mathematics teachers' autonomy over various aspects of their work and outcomes for the students they teach, and the link between teacher autonomy and teacher job satisfaction (Jerrim et al, 2023) and research investigating teacher autonomy in their work and curriculum control in public and independent schools in the context of a country with a long tradition of one public school for all (Dieudé & Prøitz, 2024).

Upon examination of national research on teacher autonomy, several studies have been identified: theoretical studies on teacher autonomy (Ertürk, 2020; Öztürk, 2011), an investigation into the relationship between teacher autonomy and student achievement (Ayral et al, 2014), an analysis of the relationship between school climate and teachers' autonomy behaviors (Çolak & Altınkurt, 2017), an exploration of teachers' views on their professional autonomy (Erbıyık & Şemin, 2024), an examination of the relationship between teacher professionalism and autonomy (Karatay et al., 2020), investigations into the relationship between teachers' autonomy behaviors and job satisfaction (Çolak et al, 2017; Şentürken, 2018), a study on school administrators' perceived management styles and teachers' autonomy (Akçay & Sevinç, 2021), research on teachers' perceptions and expectations of autonomy in planning and implementing instruction (Tokgöz Can, 2019), an examination of teacher autonomy in the context of educational leadership (Öksüz Gül, 2015), an analysis of teachers' autonomy perceptions and curriculum literacy levels (Taşdemircanan, 2023), and an investigation into the effect of teacher autonomy on commitment to the teaching profession according to teachers' perceptions (Ertürk, 2023). Notably, within the national literature, there is a predominance of quantitative studies on teacher autonomy and a limited number of studies (Özaslan, 2015; Kılınç et al., 2018) exploring how teacher autonomy is conceptualized by teachers. Özaslan (2015) conducted phenomenological research with teachers from various disciplines working in primary, middle, and high schools. The results of this study indicate that teachers primarily defined autonomy within the context of professional autonomy, emphasizing the importance of utilizing teaching materials for their own selection, implementing necessary disciplinary measures with students, and having the ability to repeat lessons when deemed necessary. Teachers reported that a lack of professional autonomy resulted in consequences such as diminished professional prestige and reduced efficacy in benefiting their students. In a study conducted by Kılınç et al. (2018), teachers' perspectives on teacher autonomy were examined using a phenomenological design with teachers who had completed their master's degree in educational administration, working in public schools at various levels of seniority.

The analysis of the study results revealed that the participating teachers defined teacher autonomy in the context of teaching processes, teachers' sense of freedom, and school climate. Furthermore, the study identified "perceived organizational support, teacher expertise, collegial collaboration, and school environment" as factors influencing teacher autonomy. Examination of the results from both studies indicates that research conducted using phenomenological design is significant in determining how teachers conceptualize and define autonomy, as well as the dimensions of teacher autonomy in Turkey. In addition, the present study is expected to contribute to the literature by examining teacher autonomy and its dimensions. This study, focusing on middle school teachers, is anticipated to contribute to the national literature, particularly in terms of elucidating teachers' perceptions of autonomy and identifying factors that influence their

autonomy. The primary objective of this study was to elucidate middle school teachers' perceptions of teacher autonomy and to explore the factors affecting teachers' autonomy based on their experiences. In alignment with this primary objective, the following questions were formulated.

1. How do teachers conceptualize teacher autonomy?
2. What are the characteristics of autonomous teachers?
3. According to the teachers, what factors influence teacher autonomy?

2. Method

This section describes the research design, participants, data collection tools, data analysis, credibility, and ethics.

2.1. Research Design

A phenomenological design, a qualitative research approach, was employed in this study. Phenomenology is a methodology used to examine the meaning, structure, and essence of a particular experience perceived by an individual or group (Patton, 2014). The philosophical underpinnings of phenomenology focus on the nature of experience and the process by which conscious experience transforms into perception (Merriam 2015; Patton 2014). Furthermore, phenomenological design investigates how participants experience a specific phenomenon (Creswell, 2020). In this study, the phenomenon of "perceptions of teacher autonomy" was subjected to in-depth investigation.

2.2. Participants

This study, conducted during the spring semester of the 2023-2024 academic year, was implemented in districts selected through convenience sampling from three provinces in northern Turkey. The districts were chosen using convenience sampling because of the researchers' professional affiliations and proximity, which minimized time and cost constraints. Given the relatively small population of the three districts, there were few middle schools. A criterion sampling method was employed to identify the participants. The criteria stipulated that teachers must work in public schools affiliated with the Ministry of National Education, represent different subject areas, and possess a minimum of five years of professional experience. In accordance with these criteria, the study's scope was elucidated for teachers employed in middle schools, resulting in 17 voluntary participants constituting the research sample. The research participants comprised 14 females and three males, with professional experience ranging from 7 to 36 years. The subject area distribution of the teachers was as follows: four Social Studies, three Mathematics, three Science, two Turkish, two English, one Visual Arts, one Religious Culture and Moral Knowledge, and one Physical Education.

2.3. Data Collection Tool

In this study, a semi-structured interview form developed by the researchers was used as the data collection instrument. The preparation of the interview questions involved an initial literature review and an examination of studies pertaining to teacher autonomy. Subsequently, a semi-structured interview form was constructed to align the study's objectives. The form was electronically transmitted to two faculty members—one specializing in teacher autonomy within the field of educational administration and another expert in curriculum and instruction—to obtain expert opinions. The interview form was finalized based on feedback from experts. A pilot study was conducted with two teachers who were not included among the study participants. The

interview form included inquiries regarding teachers' understanding of the concept of teacher autonomy, the characteristics of autonomous teachers, and the factors influencing teacher autonomy.

For face-to-face interviews with the teachers, requisite permissions were initially obtained from the Ordu University Educational Research Ethics Committee and the relevant Directorate of National Education. Subsequently, an interview schedule was devised and teachers' availability was determined. Prior to the interviews, the teachers signed an interview protocol and, with their consent, a voice recorder was employed during the interviews. Research data were collected in February and March 2023, with each interview lasting between 15 and 20 minutes.

2.4. Data Analysis

The data obtained in the research were transcribed into written text immediately following the interviews. The transcribed data were subsequently analyzed using the content analysis method. An inductive process was employed during the content analysis. In this approach, codes were generated through a detailed examination of the transcribed data by the researchers, with particular attention paid to the teachers' discourse. The codes were independently created by both researchers. Subsequently, a meeting was convened to reach consensus on the codes that would ensure conceptual integrity. The codes were categorized into groups determined by the researchers within the context of the study's fundamental phenomena. Themes were subsequently developed based on these categories. The data were organized and defined according to codes, categories, and themes. These findings have been subsequently reported. The participating teachers were assigned interviewer codes (e.g., T1, T2, T3, T17), which were incorporated into the tables and sample discourses. Direct quotations were used in the study to accurately convey teachers' statements.

2.5. Validity and Reliability

Measures were implemented within the scope of the validity and reliability of the study to ensure credibility, transferability, consistency, and confirmability. To establish credibility, face-to-face interviews were conducted with the participating teachers to facilitate direct interaction. During the data collection process, when ambiguities arose in the participants' responses, the researcher sought clarification through probing questions. This approach allowed the verification of participants' statements by the researcher. Furthermore, the interview form developed by the researchers underwent expert review and was subsequently revised based on feedback from the relevant curriculum development specialists. Regarding transferability, the participant selection adhered to the criterion sampling method. Additionally, the researchers provided a detailed account of the entire process and data analysis, incorporating direct quotations from teachers' statements in the Findings section. To ensure confirmability, two independent curriculum development experts, who were not involved in the study, were consulted for their opinions and suggestions concerning the semi-structured interview form developed for the research. Concurrently, an external curriculum development expert was requested to analyze the research data, and their insights were considered. To evaluate the consistency of the study, the research was presented to program implementer teachers, who were not included in the study, and their feedback was solicited to ensure coherence.

2.6. Ethics

All the rules specified in the Scientific Research and Publication Ethics Directive of Higher Education Institutions were followed in the study. The ethics committee approval of this study

was obtained from Ordu University Educational Research Ethics Committee with the letter dated 24/05/2024 and numbered 2024/93.

3. Findings

This section presents how teachers make sense of the concept of autonomy, the characteristics of autonomous teachers, and the factors affecting teachers' autonomy.

3.1. The Concept of Teacher Autonomy

In the first part of the study, teachers' sense of autonomy was analyzed. The findings on how middle school teachers who participated in the study made sense of teacher autonomy are discussed in detail in Table 1.

Table 1

The Concept of Teacher Autonomy

Category	Codes	Participants
Autonomy in the Education Process	To be able to choose teaching methods and techniques	T1, T3, T4, T12, T13, T16, T17
	Identify materials and resources	T4, T6, T12
	To be able to teach lessons by considering the individual differences of students	T1, T12, T17
	Ability to teach without the obligation to adhere to the curriculum	T2, T9, T10, T14, T16, T17
	To be able to take initiative in planning and implementing educational processes	T3, T5, T7, T8, T10, T11, T15
	To be able to shape their own teaching process independently	T7, T11, T15
	The belief that courses grades and assessment processes should not be interfered with	T1
Professional Development	Renewing and developing itself in accordance with the requirements of the age	T8, T16
Professional Respectability	The idea that teachers are discredited	T1
	Teachers' need for professional respect and appreciation	T1
Freedom of Expression	To be able to freely express and discuss their own thoughts	T1, T14

According to the teachers, as a result of the analyses under the theme of 'teacher autonomy concept', the categories of "autonomy in the education process, professional development, professional respectability and freedom of expression" were identified.

Twelve of the teachers (T1, T2, T3, T4, T6, T9, T10, T12, T13, T14, T16, T17) provided responses in the category of 'autonomy in the education process.' In this category, teachers emphasized their belief that they should have the ability to select teaching methods and techniques, determine materials and resources, conduct lessons while considering the individual differences of students, teach without strict adherence to the curriculum, exercise initiative in planning and implementing educational processes, independently shape their teaching process, and operate without interference in course grading and evaluation procedures. Representative statements are presented in the following quotations:

- *"An autonomous teacher is a teacher who can teach according to his/her own methods and students' characteristics." T12*

- *"An autonomous teacher is a teacher who incorporates his/her own ideas, his/her own feelings and even his/her own research and applications into the lesson without being bound to the curriculum." T9*
- *"A free and independent teacher is a teacher who can control learning and teaching processes and can change them when necessary. A teacher who has no responsibility towards the principal and the curriculum and can shape his/her own teaching process." T7*
- *"It is the type of teacher who makes decisions on his/her own and puts them into practice. A teacher who is independent and can make decisions and does not pay too much attention to those around him/her." T15*

Two educators (T8, T16) provided responses within the category of "professional development." In this category, educators emphasized self-renewal and development in accordance with contemporary requirements. Representative statements are presented below as direct quotations.

- *"An autonomous teacher is a teacher who develops and changes himself/herself according to the needs of the age and finds solutions to problems." T8*
- *"... a teacher who improves himself/herself, is open to innovations and designs his/her own teaching curriculum in different ways." T16*

One of the educators (T1) provided a response that aligned with the category of "professional respectability." Within this category, the educator emphasized the notion that teachers were discredited and highlighted the necessity for teachers to receive professional respect and recognition. The representative discourse of the educator is as follows:

- *"I don't think we are very autonomous; I think we have been discredited; I don't think we are appreciated as we deserve. There is a huge difference between when I took office 28 years ago and now. I think respect is kept to a minimum." T1*

Two of the teachers (T1, T14) gave answers in the category of "freedom of expression." In this category, teachers emphasized the ability to express and discuss their thoughts freely. Sample discourses were expressed using the following direct quotations:

- *"In the teachers' room or in the school, I think that teachers should be able to express their opinions with respect…Everyone has an opinion, and I believe that it should be respected, both in the field of education and in the personal field. We should be able to discuss, talk, and exchange information, and everyone should be able to express their opinions very easily. This is true for the teachers and the administration." T1*
- *"An autonomous teacher is a teacher who can freely express his/her own thoughts and ideas. When expressing his/her thoughts, he/she is the teacher who thinks, interprets, and applies in a democratic way in accordance with the regulations of the Ministry of National Education." T14*

Upon analysis of the research findings regarding middle school teachers' conceptualization of teacher autonomy, it was observed that teachers defined this construct in terms of autonomy in the educational process, professional development, professional respectability, and freedom of expression. The results indicated that teachers articulated their perspectives on autonomy in the educational process more frequently than in other categories, predominantly defining teacher autonomy through processes within this domain. Examination of teachers' definitions of autonomy within the context of the educational process autonomy revealed that they primarily conceptualized it in terms of taking initiative in planning and implementing the educational process, conducting lessons without strict adherence to the curriculum, and selecting teaching

methods and techniques. Middle school teachers defined teacher autonomy in the context of professional development as self-renewal and adaptation to contemporary conditions, in the context of professional respectability as the necessity to gain professional esteem, and in the context of freedom of expression as the ability to articulate thoughts without constraint.

3.2. Autonomous Teacher Characteristics

This section analyzes the teachers' responses regarding the characteristics of autonomous teachers. The findings pertaining to the attributes of autonomous teachers, as identified by the participating middle school teachers, are presented and discussed in detail in Table 2.

Table 2

Autonomous Teacher Characteristics

Category	Codes	Participants
Pedagogical Freedom and Creativity	Can make their own decisions and apply original teaching techniques	T3, T5, T10, T11, T14, T17
	Create his/her own world in the classroom	T6
	Adopting innovative and creative teaching techniques	T4, T7, T10, T11, T12, T16
	Original in materials and methods	T5, T14
Using Technology	Able to use technology well	T1, T2, T7, T8, T10
Student Orientation	Observing students' individual differences and teaching according to their characteristics	T1, T8, T9, T17
Critical and Analytical Thinking	Free of ideas and thoughts, not bound by molds	T9, T11
	Able to make split-second decisions and predict outcomes	T4
Independence and Self-Confidence	Self-confident, independent in their decisions	T6, T15
Content Knowledge and Research Ability	Knowledgeable in the field, researcher and open to learning	T3, T4, T7, T13, T14, T16, T17
Social and Communication Skills	Social, communicative, able to exchange information with his/her environment	T7, T4
Leadership and Problem Solving	A pioneer in solving problems in their environment	T8

According to the teachers, as a result of the analyses under the theme of "autonomous teacher characteristics," the categories of "pedagogical freedom and creativity, using technology, student orientation, critical and analytical thinking, independence and self-confidence, content knowledge and research ability, social and communication skills, leadership and problem solving" were identified.

Ten of the teachers (T3, T4, T5, T6, T10, T11, T12, T14, T16, and T17) provided responses in the category of 'pedagogical freedom and creativity.' In this category, teachers emphasized characteristics such as making independent decisions, implementing original teaching techniques, establishing their own pedagogical environment in the classroom, employing innovative and creative teaching methodologies, and demonstrating originality in materials and methods. Representative statements are presented below as direct quotations.

- *"A teacher who can take his/her own decisions while planning and implementing learning processes, who is liberal, who has managerial and academic knowledge and skills." T3*

- *"I perceive a teacher who is original in terms of the materials, methods and techniques he/she will use in the school and classroom, in the educational environment, and who has authority in his/her field." T5*
- *"A teacher who has created his/her own world in the classroom." T6*
- *"A teacher who is free, comfortable, self-confident, social, researching, able to observe the developmental processes of his/her students, able to direct the lesson, creative, open to innovation, open to development, follows technology, has strong communication, original, has meaningful voices in the classroom." T7*

Five of the teachers (T1, T2, T7, T8, T10) provided responses within the category of "using technology". In this category, teachers emphasized the importance of proficiency in technology utilization. Representative statements are presented below as direct quotations.

- *"As I said at the beginning, an autonomous teacher should be able to use technology well. They should be able to know their students well and take an attitude according to their characteristics." T8*
- *"I think they should support themselves with things like technology and STEM." T10*

Four of the teachers (T1, T8, T9, T17) provided responses within the category of "student orientation." In this category, teachers emphasize the importance of recognizing individual differences among students and adapting instructional methods according to their characteristics. Representative statements are presented below as direct quotations.

- *"I leave the subjects free in the classes from time to time, I tell everyone to do what they want. I mean, I have students weaving carpets, painting, cutting paper, oil painting in the same class hour." T1*
- *"First of all, they should be free in their thoughts and ideas. He should not stick to the mold. They should be open to innovation. Also, the teacher should be a teacher who can act together with the students but at the same time allow independence." T9*

Three of the educators (T4, T9, T11) provided responses within the category of "critical and analytical thinking." In this category, educators emphasized the characteristics of possessing independent ideas and thoughts, not being constrained by established patterns, making prompt decisions, and anticipating outcomes. Representative statements are presented below as direct quotations.

- *"He must be able to make instant decisions. Because or she will act within the framework of the curriculum and use new techniques. While using new techniques, he is acting in an area he does not know; in an area he has not experienced before, so he needs to be able to make instant decisions at that time. You need to have the ability to make instant and correct decisions." T4*

Two educators (T6 and T15) provided responses within the category of "independence and self-confidence." In this category, educators emphasized the importance of self-confidence and independence in their decision-making processes. An exemplary statement is presented below:

- *"She has high self-confidence and has a decisive and independent spirit. He/she does not like taking orders and sometimes he/she may even like himself/herself too much. Even when he/she has problems, instead of getting help from his/her environment, he/she can continue to proceed in the wrong but right way." T15*

Seven educators (T3, T4, T7, T13, T14, T16, and T17) provided responses within the category of "content knowledge and research ability." In this classification, educators emphasized the attributes of being knowledgeable, research-oriented, and receptive to learning. Representative statements are presented below as direct quotations.

- *"First of all, he/she should have a good command of all kinds of subjects, he/she should be able to organize well and present different perspectives." T13*
- *"They should improve themselves, be open, do research and investigation, know their students well, know their environment well, use the school facilities and conditions very well, and have the ability to change and transform all the materials they find." T17*

Two educators (T4, T7) provided responses within the category of "social and communication skills." In this category, educators emphasize social and communication skills and the ability to exchange information with others. An example of an educator's discourse is presented through the direct quotation below:

- *"A teacher who is free, comfortable, self-confident, social, researching, able to observe the developmental processes of his/her students, able to direct the lesson, creative, open to innovation, open to development, follows technology, has strong communication, original, has meaningful voices in the classroom." T7*

One of the educators (T8) provided a response within the category of "leadership and problem solving." In this category, the educator emphasized the importance of being proactive in addressing issues within their immediate environment. The following is a verbatim quotation from the educator's discourse.

- *"An autonomous teacher should be both a pioneer and a guide in solving the problems in his/her environment." T8*

Upon analysis of the research findings regarding middle school teachers' definitions of autonomous teacher characteristics, it was observed that teachers conceptualized these characteristics within the frameworks of pedagogical freedom and creativity, technology utilization, student-centered approaches, critical and analytical thinking, independence and self-assurance, content knowledge and research proficiency, social and communication competencies, and leadership and problem solving abilities. The results indicated that teachers articulated a greater number of perspectives concerning autonomous teacher characteristics in the categories of pedagogical freedom and creativity, technology utilization, content knowledge and research proficiency, and student-centered approaches.

3.3. Factors Affecting Teacher Autonomy

In the last part of the study, teachers' responses to factors affecting teacher autonomy were analyzed. In this context, the findings of the middle school teachers' views on the factors affecting teacher autonomy are discussed in detail in Table 3.

Tablo 3

Factors Affecting Teacher Autonomy

Category	Codes	Participants
Social and Environmental Factors	Society's perspective	T1, T4
	Parent interaction	T1, T4
	Geographical and economic situation	T1, T5, T7, T17
Personal and Professional Characteristics	Personality characteristics	T2, T6, T8, T15
	Education and experience	T12, T13, T14
	Professional motivation	T2, T8
Characteristics of the Institution And System	School management	T2, T7
	Education system	T10, T11
	Financial resources	T4, T7, T16, T17
	Legal regulations	T10, T11, T15
	Student characteristics	T2, T4, T9, T11

According to the teachers, the analyses conducted under the theme of "factors affecting teacher autonomy" yielded categories of "social and environmental factors, personal and professional characteristics, characteristics of the institution and system".

Five teachers (T1, T4, T5, T7, T17) provided responses within the category of "social and environmental factors." In this category, teachers emphasized societal perspectives, parental interactions, and geographical and economic situations. Representative discourses are presented in the following direct quotations:

- *"The perspective of the society and the perspective of the parents. If the parent imposes on his/her child only an exam according to the branches, your autonomy does not work there anyway. Because you are not accepted. However, my opinion was not accepted. The child does what he/she knows because he/she is asked to solve a hundred tests. The child is channeled to this, so your lesson is not important." T1*
- *"The pressure to complete the entire annual plan, time pressure, insufficient financial means of the students, and difficulties in accessing the desired resources make it difficult. In other words, one cannot realize exactly what one wants and plans. For example, if financial resources cannot be provided, every student should go to Çanakkale and see it. But there is no such possibility, basically everything is based on money." T17*

Seven of the educators (T2, T6, T8, T12, T13, T14, T15) provided responses within the category of 'personal and professional characteristics.' In this category, educators emphasized personality structure, educational background, experience, and professional motivation. Representative statements are presented below as direct quotations.

- *"Personality traits are very important, if he/she lives his/her life like that, I think it affects his/her teaching. The characteristics of the teacher also affect what kind of teacher they are, and you know that not all teachers are the same. I would like to say that there are no teachers who are only concerned with the materialistic aspect of the job; unfortunately, there are. Therefore, there may be those who say that I only teach what is in the book and the rest is not necessary." T2*
- *"I can say that the quality of the pedagogical education received by the teacher, the experience of the teacher, the attitudes of the school administration, the self-confidence of the teacher, in other words, self-confidence affects the teacher." T12*

- *"So here, the teacher's idealism first affects his/her characteristics. His/her personality... Having his/her own goals will cause him/her to improve himself/herself and his/her perspective towards his/her environment will also be effective." T8*

Nine of the teachers (T2, T4, T7, T9, T10, T11, T15, T16, T17) provided responses within the category of "characteristics of the institution and system." In this category, teachers emphasized factors such as school management, the education system, financial resources, legal regulations, and student characteristics. Representative statements are presented below as direct quotations.

- *"First of all, the school administration is very important for the teacher to be autonomous in this regard, that is, if they follow what the teacher teaches or does not teach, the teacher feels stuck, but if they leave the education and training to the teacher and deal only with paperwork, the teacher always moves more easily….Therefore, the climate of the school, your colleagues, and their relationships with them are also very important. If those people are like you, you exchange ideas more, you know better what to do and what to do." T2*
- *"Since teachers are civil servants, their autonomy is restricted in certain areas. They cannot engage in politics, speak to the press without permission, criticize political authority, etc. In addition, systematic mobbing and pressure in schools also prevents teachers from becoming autonomous. Legislation or excessive bureaucracy are also attitudes that prevent autonomy." T15*

Analysis of the research findings pertaining to middle school teachers' perspectives on factors influencing teacher autonomy shows that educators identify social and environmental factors, personal and professional characteristics, and institutional and systemic attributes as significant determinants. The study concludes that teachers emphasize geographical and economic conditions as more influential among the social and environmental factors affecting teacher autonomy. Furthermore, personality structure, education, and experience have been highlighted as the predominant personal and professional characteristics that impact teacher autonomy. Additionally, financial resources, student characteristics, and legal regulations were identified as the most significant institutional and systemic factors that influence teacher autonomy.

4. Conclusion and Discussion

In this study conducted in the context of teacher autonomy, findings were obtained in the themes of "The Concept of Teacher Autonomy," "Characteristics of Autonomous Teachers" and "Factors Affecting Teacher Autonomy." The findings obtained from each theme reveal a comprehensive perspective on how teachers conceptualize teacher autonomy according to the characteristics of autonomous teachers and the factors influencing teacher autonomy.

Within the scope of the study, when the perspectives of teachers on the concept of teacher autonomy were analyzed, it was concluded that teachers predominantly interpreted teacher autonomy as autonomy in the educational process. In this context, teachers desire the ability to freely select teaching methods and techniques, exercise initiative in planning and implementing educational processes, independently shape their own teaching processes, determine materials and resources in the teaching process, and conduct lessons considering the individual differences of students. In addition, some teachers expressed the belief that course grades and evaluation processes should remain free from external interference. These results can be attributed to the teaching process autonomy dimension of teacher autonomy. According to Pearson and Moomaw (2005), teaching process autonomy pertains to lesson instruction and classroom management, wherein the teacher is the individual who independently determines the methods to be employed in lesson instruction, the teaching materials to be utilized, the time allocation for the lesson, the management of assessment processes, communication within the lesson, and classroom

management. Lai-ngok (2004) defined autonomy in the teaching process as the capacity of a teacher to exhibit autonomous behaviors while planning, implementing, and evaluating educational activities. From this perspective, teachers assume responsibility for planning instruction, organizing activities, managing assessment processes, selecting teaching methods, and utilizing teaching materials in alignment with the aims of education.

An additional outcome that educators interpret as part of their autonomy in the educational process is their desire to teach without being constrained by centrally mandated curricula. This result may be associated with the curriculum autonomy dimension of teacher autonomy. Curriculum autonomy should provide teachers with necessary flexibility. In the curriculum development process, teachers should collaborate with colleagues and input into the curriculum design. Educators should have the flexibility to update curricula in accordance with changing conditions, student needs, and educational objectives (Çolak & Altınkurt 2017). According to Taba's (1962) curriculum development model, teachers should play an active role in the curriculum development process. From this perspective, the curriculum is developed by those who implement it and teachers are considered integral to the curriculum development process. When examining the results in the context of teachers' instructional process autonomy and curriculum autonomy collectively, it is evident that teachers desire autonomy in organizing, implementing, and evaluating learning and teaching processes within the curriculum. This is an anticipated outcome for educators, as they are the implementers of the curricula, and it is challenging for teachers to adhere strictly to the prescribed curricula. Teachers are expected to view centrally mandated curricula as a framework and make adjustments in alignment with the needs of students, schools, environments, and regions. While curricula serve as a framework, this situation underscores the need for curricula to be flexible. However, the flexible nature of curricula does not imply that teachers have unrestricted freedom in curriculum implementation. This is because teacher autonomy is not perceived as an unlimited freedom, where educators can act without constraints (Gürsoy, 2020).

Another finding related to teachers' definitions of autonomy is professional development. Several educators have emphasized that teachers need to update and develop their skills in accordance with contemporary requirements. This result aligns with the dimension of professional development autonomy of teacher autonomy. Educators should be capable of facilitating professional development in subjects pertaining to their respective fields and pedagogical skills. Teachers should have the opportunity to receive necessary training aligned with their needs, attend scientific conferences, and participate in in-service training without external pressure from authorities (Çolak & Altınkurt 2017). Another perspective emphasizes that continuous professional development is associated with teachers' professional growth and instructional competencies (Eurydice, 2008). Within the scope of this research, it was also concluded that one teacher interpreted the concept of teacher autonomy in the context of professional prestige. This view highlights the perception that teachers are undervalued and emphasizes the need for educators to be respected and esteemed professionally. This perspective is supported by the observation that the teaching profession has experienced a significant decline in its societal esteem in recent years. Finally, it was determined that teachers interpreted the concept of teacher autonomy as freedom of expression. In this context, educators have emphasized that teachers should be able to freely articulate and discuss their thoughts. This finding relates to the professional communication autonomy dimension of teacher autonomy. According to Çolak (2016), teachers should be able to express their opinions and thoughts freely and act without constraints while communicating. Educators should be able to communicate with colleagues, administrators, and parents without experiencing pressure or anxiety.

Upon examination of the results pertaining to the second research question, it was determined that teachers predominantly emphasized the characteristics of pedagogical freedom and creativity,

utilization of technology, student-centered approach, content knowledge, and research aptitude as essential attributes of an autonomous teacher. In this context, an autonomous teacher is defined as an educator who can make independent decisions, implement innovative and creative teaching methods and techniques, establish a unique classroom environment, demonstrate originality in the selection of learning and teaching materials, effectively utilize technology, consider students' individual differences, adapt lessons according to student characteristics, possess comprehensive field knowledge, and maintain a research-oriented and learning-receptive disposition. According to Phan (2012), autonomous teachers still instill a sense of responsibility for individual learning in students and guide them through their behaviors. In classrooms led by autonomous teachers, students anticipate guidance from their instructors to determine activity goals, allocate time to the teaching-learning process, and identify problems. Lamb (2008) posits that the freedom of teachers to select their preferred teaching methods and techniques is characteristic of an autonomous educator. In addition to these perspectives, the literature suggests that teacher professionalism is fully realized when teachers exhibit autonomous classroom characteristics. A reduction in teacher autonomy leads to a decrease in professionalism (Jeong and Wermke, 2019; Jeong & Luschei, 2018). Consistent with this view, a professional teacher who excels in their role is expected to possess the general competencies of the teaching profession. The Ministry of National Education has delineated in detail the characteristics that teachers should possess within the scope of general competencies in the teaching profession. The attributes encompassed within the competency areas of professional knowledge, professional skills, attitudes, and values are among those that can enhance a teacher's autonomy. In this regard, the characteristics that a teacher should possess include possessing advanced theoretical, methodological, and factual knowledge in the field to incorporate a questioning perspective; mastering the curriculum and pedagogical content knowledge of the field; effectively planning education and training processes; selecting appropriate materials; managing the evaluation process in accordance with its purpose; utilizing technology effectively in the learning and teaching process; considering the individual differences and needs of students in learning environments; communicating and collaborating effectively with students, colleagues, families, and other stakeholders in education; and conducting self-evaluation and pursuing personal and professional development (MoNE, 2017).

Educators also emphasized the characteristics of autonomous teachers in terms of critical and analytical thinking, independence and self-assurance, social and communication skills, leadership, and problem-solving abilities. In this context, according to educators, an autonomous teacher is one whose ideas and thoughts are unrestricted; they do not adhere to rigid patterns, who can make immediate decisions and anticipate the consequences, who is self-assured, independent in their decisions, socially adept, communicative, capable of exchanging information with their environment, and who is a pioneer in addressing problems in their surroundings. According to Ramos (2006), teacher autonomy develops through self-awareness, environmental sensitivity, participation, and problem-solving. Self-evaluation, adaptation to changing needs, collaboration, and creative thinking are significant factors that enhance teachers' autonomy.

Analysis of the results pertaining to the final research question of the study revealed that the factors influencing teacher autonomy were social and environmental factors, personal and professional characteristics, and institutional and systemic attributes. Within the context of social and environmental factors, teachers emphasized societal perspectives, parental interactions, and geographical and economic conditions. It was determined that circumstances such as parental evaluation of teachers based on their subject areas, societal acceptance of teachers according to their disciplines, unfavorable geographical conditions, insufficient financial resources of students, and difficulties in accessing desired resources negatively impacted teachers' autonomy. Regarding personal and professional characteristics, the teachers highlighted personality, education, experience, and professional motivation. It was concluded that factors such as the teacher's

personality type, self-confidence, multidimensional thinking, idealism, goal setting, environmental perspective, self-education, subject matter expertise, achievements, quality of pedagogical education, and experience influence teachers' autonomy. Teachers' continuous professional development positively affects their autonomous behaviors in the teaching-learning process. These teachers can create more effective and efficient learning and teaching environments for their students (Çolak, 2016). Teachers' competence in their areas of expertise positively influenced their self-confidence and motivation. High motivation and professional competence enable teachers to act with greater sense of responsibility, creativity, and innovation. This, in turn, leads to more effective and efficient autonomous behaviors (Pearson & Moomaw, 2005). Concerning the characteristics of the institution and system, teachers emphasized school administration, education systems, financial opportunities, legal regulations, and student characteristics. One of the findings of this study is that constant supervision of teachers by the school administration creates a sense of constraint and negatively affects their autonomy. School administrations are expected to comprehensively support teachers. The leadership behaviors of school administrations have a significant impact on teachers' autonomy. According to Garvin (2007), a school environment in which school administrators exhibit supportive leadership behaviors positively affects teacher autonomy. School administrators' provision of collaborative learning and teaching environments and the implementation of practices that support professional development increase teachers' autonomy levels. Benson (2010), however, stated that parental complaints and the school administration's authority over teachers create a sense of constant supervision, which limits teachers' autonomy, decreases teachers' self-confidence and self-efficacy in such an environment, and leads teachers to avoid autonomous behaviors.

Another conclusion drawn from this study is that curricula compel teachers to serve the examination system. The aims of administrators, institutions, and educational authorities to regulate teachers' actions are factors that limit their autonomy. These can be regulations such as mandatory exam practices, curricula, and administrator demands (Ramos, 2006). According to Çolak (2016), educational policies exert pressure on teachers and negatively affect their autonomy. This situation impedes teachers from making decisions freely and diverts them from taking responsibility for education. One of the most significant results of this study is the negative effect of legal regulations on teacher autonomy. It was concluded that the inability of teachers to criticize political authority due to their status as civil servants, the prohibition on speaking to the press without permission, legislation regulated by laws and regulations, and excessive bureaucracy negatively affect teachers' autonomy. Benson (2000) states that constraints from sources outside the school through policies and procedures limit teachers' autonomy. Ingersoll (2007) argues that excessive external control hinders teachers' ability and flexibility to work effectively and reduces teachers' motivation. Çolak and Altınkurt (2017) stated that teacher autonomy is limited within the framework of previously agreed norms, universal ethical codes, laws, and scientific and pedagogical principles for the school to achieve its goals. In line with these views, it is possible to assert that legal regulations limit teacher autonomy. It is probable that teachers' autonomy will increase in institutional and systemic contexts when strict legislative regulations that limit teachers' autonomy are made more flexible.

Another result of this study is that material resources negatively affect teachers' autonomy. Material shortages in schools due to limited financial resources negatively impact teachers' autonomy. In his 1997 study, Crookes emphasized that one of the factors affecting teacher autonomy is the lack of sufficient financial resources for curriculum. The final and noteworthy result obtained in this study is that student characteristics affect teacher autonomy. The psychological, sociological, and economic conditions of students and their levels of readiness are factors that influence teacher autonomy. It is posited that if students in a school are in a favorable condition in every aspect, it will positively affect the teacher's autonomy. Each student is unique

as an individual and possesses different types of intelligence. This implies that teachers should organize learning-teaching processes according to student characteristics, and in this context, they should be able to select various activities according to students' individual differences and make their decisions independently in the teaching process. In this context, the diversity of student characteristics is related to teachers' autonomy.

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Ethics Committee Permission:

All the rules specified in the Scientific Research and Publication Ethics Directive of Higher Education Institutions were followed in the study. The ethics committee approval of this study was obtained from Ordu University Educational Research Ethics Committee with the letter dated 24/05/2024 and numbered 2024/93.