International Journal of Psychology and Educational Studies, 2022, 9(1), 211-229

IJPES

www.ijpes.com

International Journal of Psychology and Educational Studies

ISSN: 2148-9378

The Analysis of Problem Posing Skills about Integers of Prospective Primary School Mathematics Teachers Who Have Experienced in Problem Posing

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ARTICLE INFO

Article History
Received 29.04.2021
Received in revised form 11.06.2021
Accepted 18.08.2021
Article Type: Research Article

ABSTRACT

This study aims to analyze the problem-posing skills of primary school mathematics teacher candidates with problem-posing experience and their views on problem posing. The case study, one of the qualitative studies, was used in the study. The study group is ten prospective elementary mathematics teachers who were selected using the purposive sampling method and are in their third year in the academic years 2020-2021 Teaching Mathematics in Primary Schools Major at a private university in Istanbul.The data collection process consists of two stages: 9 problem-posing drafts in total for performance evaluation prepared by examining the literature and obtaining an expert opinion and semi-structured interview forms with three questions. The participants were asked to pose problems on the subject of integers. The problems were evaluated and analyzed by the researchers and two mathematics teachers according to the problem-posing evaluation criteria developed by the researchers. As a result of the findings obtained in the performance determination phase of the study, it was determined that the participants posed more successful problems in the case of structured problem posing. It was determined that some of the problems were not problematic; they were prepared without paying attention to grammar rules, the sentences were not in a clear and logical framework that the middle school students could understand. The numbers were not used according to a certain logic pattern to make the problem solvable. Some problem situations were left unanswered. In the second stage of the study, the data obtained through semi-structured interviews with the primary school mathematics prospective teachers were analyzed using content analysis. In examining the research findings, the main issues are what the participants pay attention to in problem setting, whether they emphasize problem setting in the instructional process, whether problem setting is necessary for each student, and whether anxiety occurs in problem setting.

Keywords:
Mathematics education, problem posing, mathematics prospective teachers, integers

1. Introduction

Teaching mathematics with traditional methods in the 21st century may not be helpful to acquire the skills of this century. For this reason, teachers should design the mathematics course for students to participate in mathematics lessons actively. Problem posing is on the agenda as one of the activities that foster active learning (Kwon & Capraro, 2021). There are studies emphasizing the importance of posing problems in our country (Akay & Boz, 2010; Arıkan & Ünal, 2014; Dede & Yaman, 2005; Ev-Çimen & Yıldız, 2018; Kaba & Şengül, 2016; Kılıç, 2013). It is seen that problem-posing is emphasized in the secondary school mathematics curriculum,

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Citation: Kapıcıoğlu, G. & Arıkan, E. E. (2022). The analysis of problem posing skills about integers of prospective primary school mathematics teachers who have experienced in problem posing. *International Journal of Psychology and Educational Studies, 9*(1), 211-229. https://dx.doi.org/10.52380/ijpes.2022.9.1.555

which has been updated with these studies and is currently in force. Raising individuals who believe in the benefit of mathematics, have a critical point of view, can solve problems, pose problems, and have affective skills specific to mathematics is among the goals of mathematics education (Ministry of National Education [MoNE], 2018a).

Individuals who can solve problems can also create a starting point for other problems in the problem-posing phase by reformulating the problem (Kilpatrick, 1987). From this point of view, emphasis is placed on implementing original problem-posing processes in the mathematics education program applied in Turkey (MoNE, 2018a).

Knowing mathematics and being involved in Mathematics means having reasoning skills and having skills to be able to solve problems encountered in daily life (Altun, 2006). In the simplest form, numbers can be seen in measuring, shopping, interpreting graphics and establishing formulas (Işık, Çiltaş & Bekdemir, 2008). Since every learned concept is a step for the upcoming concepts in Mathematics, difficulties in learning or misinformation will lead to a misunderstanding for other concepts (Soylu & Soylu, 2005). For instance, when the integer subject is not completely understood, it will cause a misunderstanding about the exact meaning of the concepts in exponential and root numbers. There will be some difficulties in determining the operation sign when the number in the root is negative and the number in the base and exponent is negative (Duatepe Paksu, 2010). As Mathematics classes are conducted cumulatively, teaching integers before passing through the exponential and root numbers (Kutluca, 2012). Similarly, it is necessary to have a complete understanding of negative integers before transitioning from arithmetic operations to algebraic thinking (Linchevski & Williams, 1999). Therefore, the integer unit should be emphasized thoroughly by thinking that it constitutes the basis of abstract thinking to realize conceptual and operational learning.

Theoretical Framework

Problem posing and problem-solving as an alternative way of assessment.

People who can approach problems with a different perspective can produce more different and various solutions to them. For this reason, the problem-solving process is a critical element of mathematics classes, and putting problem-solving at the center of the curriculum can make educators give a special emphasis to this process (Berisha, 2015). Studies conducted to improve problem-solving skills involve first understanding the problem, developing a strategy for the solution, implementing the strategy, verifying whether the solution is correct or not, generalizing the solution to other problems, and posing similar problems.. In short, raising people who can "solve problems" is among the expectations of the teaching program (Bintaş & Yazgan, 2005). There is a positive relationship between problem-posing skills and problem-solving skills, and also, problem-posing skills are as important as problem-solving skills (Kojima, Miwa, & Matsui, 2015). While problem-posing contributes to developing skills such as creativity, reasoning skills, and understanding concepts, it is also used as an assessment tool about individuals' mathematical abilities and knowledge (Lin, 2004).

Problem posing, the initial stage of problem-solving, is defined as generating new problems by students or creating different problems by changing an existing problem (Silver, 1994). Although it is seen as an operation only composed of writing, it is a long and comprehensive process contrary to the general opinion (Ev-Çimen & Yıldız, 2018). The biggest difference between the problem-posing operation and problem-solving is that it is a comprehensive process and requires reasoning skills (Çıldır & Sezen, 2011). In other words, problem-posing develops skills like internalizing mathematics concepts, expressing them by using a mathematical language, and being able to use mathematical expressions (Akay, Argün, & Soybaş, 2006). Problem posing provides convenience for students to express themselves both in verbal and written ways during mathematics classes. Besides, it also helps students to discover their levels in mathematics classes (Gür & Korkmaz, 2003). Especially, more studies on problem posing in mathematics lessons can provide a better understanding of students' mathematical thoughts (Cai & Hwang, 2020). In the studies, problem sets are found to enable people to be communicative, questioning, critical thinking, analyzing their environment and developing similar behaviors (Nixon Ponder, 2001). Guezel and Biber (2019) emphasize that problem settings have a positive effect on affective processes such as motivation and attitude. Thus, students who pose a problem develop positive attitudes toward mathematics and overcome prejudices about the problems in which they have difficulties (Altun, 2001). At the same time, problem-posing is an assessment tool that can measure students' knowledge of mathematical concepts and structures (English, 2020). When problem posing is used as an assessment tool, students' misconceptions and mistakes about mathematical concepts can be revealed (Cai & Hwang, 2020).

In the problem-posing process, most of the students can have difficulties reasoning while employing information. Notably, they can display incorrect approaches in problem-posing stages. At this point, teachers have most of the responsibility. For students to understand the problem and have problem-posing skills, teachers must know suitable methods and strategies according to the levels of their students. For this, teachers should conduct activities that are suitable to their student's individual development. We need well-equipped teachers to create higher quality problems, which will increase our students' creativity (Dede & Yaman, 2005). For this reason, it is necessary to make prospective teachers take problem-posing skills in teacher training programs (Gonzales, 1994).

Teachers can use problem posing as an alternative testing and assessment activity. The challenges which are faced by students and the points which students have difficulty understanding can be detected in the studies which are carried out to develop problem-posing skills (Işık & Kar, 2015). Detecting students' challenges and misconceptions will contribute to students in their learning process and be beneficial to teachers to increase the quality of their teaching (Arıkan & Dede, 2020).

When the literature is examined, it is seen that several researchers (Brown & Walter, 2005; Gonzales, 1994; Stoyanova & Ellerton, 1996) have developed a problem-posing strategy. In this study, the strategy developed by Stoyanova and Ellerton was used. Ellerton and Stoyanova (1996) classified their studies as structured problem posing, free problem posing and semi-structured problem posing. Free problem-posing includes creative problems which are posed by moving from any given situation without a restriction. In semi-structured problem posing, it is asked to pose problems that involve an image, a table, a story, or a situation given to the students. However, structured problem posing is expected to pose a problem that is suitable to the solution or the answer of a given problem (Stoyanova & Ellerton, 1996).

Why are Integers important?

One of the mathematics topics that we see students having difficulties in terms of learning is students' mistakes and misconceptions frequently is the unit called integers and problems associated with integers (Kilhamn, 2008). The studies show that the integers, especially negative ones, generate difficulties for the students because students assume that their knowledge of natural numbers is also valid for the integers by dealing with the integers as natural numbers (Gallardo, 2002). Students who cannot visualize that negative numbers show a direction have problems in situations such as extracting the bigger number from the smaller one and extracting a positive number from a negative one (Bağdat & Yenilmez, 2014). It is suggested to deal with daily challenges like income-depth, profit-loss, and below-over sea level (Ministry of Education [MoNE], 2008a).

Students have encountered numbers in every part of their academic and daily lives since they started school. When students do operations with natural numbers, they meet with negative numbers in the next stage. Together with the differentiation of the needs, it is achieved cardinal numbers first, then natural numbers by adding them zero, which expresses absence. Finally, it is time for the integers due to insufficiency of the natural numbers (Cihangir & Çevik, 2020). While counting numbers can be made concrete by representing them with objects in mind, operations performed using negative numbers can be interpreted with the logic of mathematics (Kiraz & Işık, 2020). It is important to give students this logic in the best way possible by associating negative integers with daily life and including them in the process (Akyazı & Kaplan, 2018).

In the Mathematics teaching program, which was re-written by the Ministry of Education in 2018, students meet with the integers in 6th grade. They study four operations with integers that are difficult to understand in the 7th grade when they start to understand abstract concepts. Within the scope of the national-level education program and international-level reform studies related to mathematics education, it is emphasized that associating integers with real-life will help students to understand integers better (NTCM, 2000). Learning the unit of the integers and imagining the operations performed with these numbers are important as they form a foundation for the units to come (Doğan & Işıtan, 2018). Learning the unit of integers will significantly contribute to learning other mathematical units that are interrelatedStudents who understand positive numbers with the help of decimal numbers have difficulties in problems involving operations with negative numbers as they encounter negative integers for the first time (İpek & Ünal, 2009). The purpose of the Primary

School for 6th-8th Grades Teaching Mathematics Program and Guide, which was enacted in 2005 (MoNE, 2005), is to improve students' communication, association, and reasoning skills by offering different modelling methods for the modelling of integers to overcome these difficulties. At the same time, it is foreseen to include studies for students to find solutions by making sense of the problems posed on four operations, such as addition and subtraction with positive and negative numbers (MoNE, 2018a). While positive numbers can be concretized using real objects, problems created with negative numbers are interpreted using logic (Bahadır & Özdemir, 2013).

Understanding negative numbers will ease the learning of the following subjects. For instance, not completely learning negative numbers conceptually is the basis of the difficulties that students have in the algebra learning field (see. Seng, 2010).

Integers are the basis for advanced subjects in mathematics education, and they should be understood and learned by students rather than memorizing them (Dereli, 2008). After detecting the difficulties and misconceptions of students when they have operations with integers, it is seen that teachers and researchers have tried various teaching methods or materials as a solution to this situation (Fuadiah, Suryadi, & Turmudi, 2017). Performing activities on problem posing by associating information about integers with daily life can be applied as one of the teaching methods that will contribute to students' understanding of integers more easily (Berkant & Yaren, 2020). Since it is recommended to use examples such as profit-loss, debit-credit, elevator, thermometer from daily life during the teaching of integers in the curriculum of the mathematics course, which was reorganized in 2018, it is believed that doing problem-posing activities by making use of these examples related to integers will be more successful in learning integers. However, the purpose of this study is both to learn the competencies of prospective teachers regarding integers by means of problem posing and their preference about whether they will use problem posing in their future teaching careers. If the teachers have any misconceptions, associations, or understanding problems, it is dangerous to transfer the same problems directly to the students (Can, 2019). In addition to this, at this point, their opinions about whether problem-posing studies contribute to their improvement or not will also affect their positions in using problem-solving activities when they become teachers. Problem posing has a positive effect on academic achievement in teaching integers (Özdemir & Şahal, 2018) and enables students to use integers in contexts (Wessman-Enzinger & Tobias, 2020).

By moving from the explanations based on the literature, since there are challenges in teaching and learning integers subject, the purpose here is to conduct a study with the participation of prospective teachers about their different problem-posing situations in integers.

The strategy developed by Stoyanova and Ellerton'un (1996) was used as the purpose of this study is to analyze problem-posing types of prospective teachers according to different problem-posing situations. Thus, the thinking processes of prospective teachers in different problem-posing situations will have been presented.

By moving from here, this study aims to analyze problems posed by primary school mathematics prospective teachers about integers. In this sense, the answers to the following questions were searched;

- What are the skills of prospective mathematics teachers in posing free, semi-structured, and structured mathematics problems related to integers?
- What do primary school mathematics primary teachers think about using problem posing for the assessment of integers?

2. Methodology

2.1.Research Model

The case study method, which is one of the qualitative research methods, was used to study the problem-solving skills of prospective teachers. Yin (2009) defines a case study as a method in which the focus is on the questions of why and how, and the answers to these questions are pursued through cases with variables that cannot be controlled by the researcher. The purpose of qualitative research is to examine events in their natural flow rather than to collect data numerically. The goals of qualitative researchers are to describe the study group in detail and to investigate the topic from the participants' perspective (Koç Şanlı, 2018).From this point of view, using the case study, an in-depth examination was made about the prospective primary school mathematics teacher skills in different problem-posing situations regarding integers and their views on problem posing. While Creswell (2014) defines a case study as processes or designs that discover activities and actions, Fraenkel and Wallen (2006) define it as a deep examination of an individual, a school, or a group.

2.2. Research Sample

Ten prospective teachers who study mathematics in Primary Schools at a private university located in Istanbul in the 2020-2021 academic years are the study group of the research. They were selected using a purposeful sampling method. Certain criteria are considered when determining the study group in the purposeful sampling method (Patton, 1987). The criterion specified for the participants of this study is to have completed their problem posing and teaching numbers classes within their undergraduate education.

2.3. Data Collection Tools and Procedure

The data collection process includes two stages. Since we carry out distance education because of pandemics, Google Forms were used for problem posing draft, which is the study's first stage. Microsoft Teams Software was used to conduct semi-structured interviews in the second stage of the research as everybody can easily assess these forms and software. There is a problem-posing draft in Google Forms which contains free, semi-structured, and structured problem-posing situations. The opinions of two experts were collected to decide whether the created problem-posing draft is suitable to the research objectives. The problem-posing draft was finalized following the opinions of experts and conducted to the prospective teachers by adding shape for a semi-structured state.

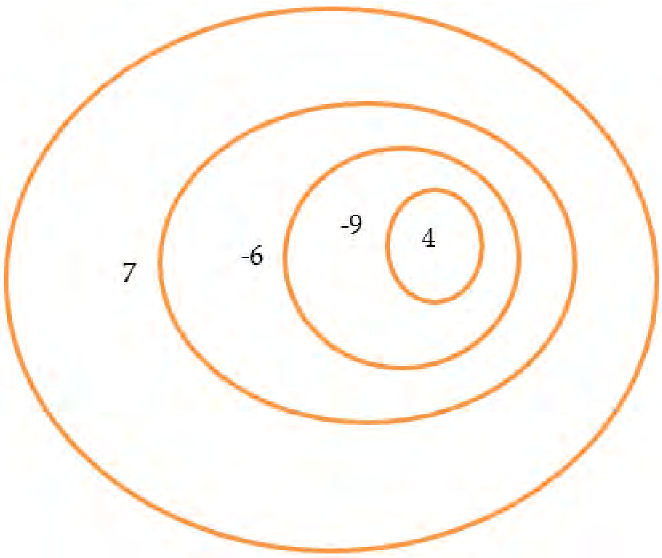
Questions in the Problem Posing Outline

Questions about Free Problem Posing;

1. Create a problem that requires four operations about integers at the middle school 7th-grade level.
2. Create a problem about integers that you think is interesting.
3. Create a problem about trade.

Questions about semi-structured Problem Posing;

1. Create a problem containing the following solution (-22) + (9x4) = +14.
2. Write a problem that is suitable for the figure.



3. Create a problem by using prompts.

Computer Games

Achieved Task 30 points

including 20 tasks

Unsuccessful Task 10 points

Questions about structured problem posing (Bayraktar, 2020);

1. A swimmer has jumped into the sea from a diving board that is 6 meters above sea level. Since the total distance she jumps is 8 meters, how many meters is the swimmer below sea level? Write a problem that is similar to this problem.
2. After a seed sown 10 cm deep begins to germinate, it grows 2 cm every three days. Accordingly, 24 days after germination begins, what is the length of the part of the seedling that remains above the soil? Please write about a problem similar to this.
3. In a 25-question integer test, students earn 5 points for each correct answer they give and lose 2 points for each incorrect answer. When Fatma finishes the test without leaving any blank, how many points will she get since she has 19 correct answers? Please write about a problem similar to this problem.

After implementing the problem-posing outline, semi-structured interviews were conducted with prospective teachers in the second stage of the study. The semi-structured interview form was prepared as involving three open-ended questions after collecting the opinions of an expert. The purpose of asking these questions in the interview form is to collect the opinions of prospective teachers about the problem-posing process with integers.

The Semi-Structured Interview Form

1. Which of the free, semi-structured, or structured problem-posing situations in the problem-posing outline did you have more difficulty? Why?
2. Which stages did you follow, and what did you pay attention to most when posing problems in the problem-posing outline?
3. Do you think problem posing is a useful process? What does it mean to you? What is your general opinion about the problem-posing process?

2.4. Data Analysis

The data obtained from the problem-posing outline were evaluated using a problem-posing evaluation scale by two mathematics teachers and the researchers. The reason why four people carried out the evaluation carried out the evaluation is the desire to have a reliable and valid evaluation of the data obtained from the problem-posing outline. When the answers given to the problem-posing outline were evaluated, the following formula was used to find the reliability coefficient; [Agreement / (Agreement + Disagreement)] *100. As a result of the calculation, the reliability coefficient of the study was found to be 80% and since it was above 70%, it was accepted as reliable (Huberman & Miles, 1994). When writing the assessment criteria for the task, it was necessary to make sure that the task was written clearly and in accordance with the grammatical rules so that students could understand what the task meant when they read it (e.g. Arıkan & Ünal, 2013). While preparing the evaluation criteria, items that include the indispensable elements of the problem, which are easy to apply and which can be understood by everyone in the same way, were written. Then, a lesson hour was discussed with eight teachers who are experts in mathematics education fields. The final form was obtained by removing the unanimous items from the first draft consisting of 6 questions and 6 degrees.

One of the problems created by the prospective mathematics teachers about integers was analyzed, and it was examined whether the problems posed about integers are proper problem statements in terms of grammar, spelling, and ambiguity, whether the problem statements were written clearly and understandably, whether they are related to integer subject, whether they are suitable to the middle school level and whether the data in the problem statement is enough for having a solution. The problem-posing evaluation criteria and scoring scale developed by the researchers were given in Table 1.

Table 1. *Problem posing Evaluation Criteria*

	0 Point	1 Point	2 Points
1) Is the problem statement written according to grammar rules?	Not written according to grammar rules	Partly written according to the grammar rules	Written according to the grammar rules
2) Is the problem statement written clearly and understandably?	The problem statement is not written clearly and understandably	The problem statement is partly clear and understandably	The problem statement is written clearly and understandably
3) Is the Problem statement related to integers?	It is not related to integers.	It is partly related to integers.	It is about integers.
4) Is the problem statement suitable for the middle school level?	It is not suitable for the middle school level	It is partly suitable to the middle school level	It is suitable for the middle school level
5) Is the data given in the problem statement enough for the solution??	Not solvable	Partly solvable	Solvable

Although the first and second items seem close in the evaluation criteria, the correct use of Turkish by the prospective teachers was prioritized in the first criterion. Because every teacher, who writes problems, should have knowledge of Turkish grammar rules. In the second criterion, it was taken into account that the narrative should be clear and understandable.

In the evaluation of the problems posed by using evaluation criteria, prospective teachers were coded T1, T2, T3, ...T9. The teacher who was coded as T8 was taken as an example. The free, semi-structured, and structured problems of T8 obtained 72 % from the scale were given in Table 2.

Table 2. *The Evaluation of the Problems Created by the Prospective Teacher Coded as T8*

		Criteria	Score	Total
Free Problem Posing	Zeynep, who got onto an elevator whose floors are indicated with numbers on the floor -2, will go up to floor 3. Ali multiplies the numbers showing the floors between the floor he is on and the floor he will get off. In conclusion, what is the result of Zeynep?	Grammar Rules	1	8
		Being Understandable	1	
		Related to the Topic	2	
		Suitable to the level	2	
		Solvability	2	
	A cooler reduces the room's temperature where it is located by 4 degrees in half a minute. In a room with a temperature of 18 degrees, the cooler is operated for 5 minutes. What is the temperature of the room after 5 minutes?	Grammar Rules	1	8
		Being Understandable	1	
		Related to the Topic	2	
		Suitable to the level	2	
		Solvability	2	
	A call is 13 kurus per minute in a mobile operator's tariff. Accordingly, if Veli, who uses this tariff and is called for 320 minutes during March, puts 20 TL to his line at the beginning of April, how many minutes of phone calls can he make?	Grammar Rules	2	8
		Being Understandable	2	
		Related to the Topic	0	
		Suitable to the level	2	
		Solvability	2	
Semi-structured Problem posing	There are award-winning and unfortunate questions in the Olympic exam questions consisting of mathematics and Turkish questions. If the unfortunate questions are solved incorrectly, the student will lose an additional 2 points. If the student solves the award-winning question, she earns an additional 4 points. There are 5 and 4 award-winning questions and three unfortunate questions in Mathematics and Turkish, respectively. How many additional points can one of the students get for his score since he got all the prize questions correctly and got all the unfortunate questions wrong?	Grammar Rules	1	7
		Being Understandable	1	
		Related to the Topic	1	
		Suitable to the level	2	
		Solvability	2	
	Students will shoot nested hoops. After three shots, the winner will be decided by adding up the scores from the shots. Deniz shot at the positive numbers. The sum of the Tuğba's shots is -	Grammar Rules	1	8
		Being Understandable	1	

	8'dir. Elif shot at two negative and one positive numbers. According to the given information, which of the following is wrong? A) Deniz may hit number 7 B)Elif got a maximum of -8. C) Tuğba definitely exceeded Elif's score. D) Deniz got the highest score.	Related to the Topic	2	
		Suitable to the level	2	
		Solvability	2	
	For every successful task in a video game Thirty points are awarded and 10 points for each failed mission. Selin, who played this game, finished the game consisting of 20 missions. How many points did Selin receive at the end of the game, given that the ratio between the number of successful missions and the number of failed missions is 2?	Grammar Rules	1	9
		Being Understandable	2	
		Related to the Topic	2	
		Suitable to the level	2	
		Solvability	2	
Structured Problem Posing	The fishing line that a fisherman throws into the sea is 25m below sea level. The fisherman waiting for half an hour is pulling his fishing line up 14m. How many meters is this fisherman's fishing rod below sea level?	Grammar Rules	1	8
		Being Understandable	1	
		Related to the Topic	2	
		Suitable to the level	2	
		Solvability	2	
	Aunt Ayşe has planted bean seeds in her garden at a depth of 10 cm. When the beans are given regular water, they grow in length every two days. Since the length of the bean on the soil is 22 cm after 20 days, please find out how many cm it grows every two days?	Grammar Rules	2	8
		Being Understandable	2	
		Related to the Topic	1	
		Suitable to the level	1	
		Solvability	2	
	Eleven traditional type-exam questions about integers were prepared and scored according to their level of difficulty. Ms. Tuğba Teacher has added the 11th question as a bonus of 5 points. In this question, students were asked to write and solve a problem. The remaining ten questions were written in order by their difficulty levels. The first six questions are 10 points. Since the scores of other questions are different from each other, and they are odd numbers at the same time, what is the maximum score of a student who can give a correct answer for question 7 and as well as the bonus question?	Grammar Rules	1	8
		Being Understandable	1	
		Related to the Topic	2	
		Suitable to the level	2	
		Solvability	2	

Content analysis was created based on the answers obtained as a result of the questions in the semi-structured interview form and asked the primary school mathematics teacher candidates during the interview following the process. The candidates, who were asked the question which one they had the most difficulty in according to their problem-posing situations, stated that they had the most difficulty in semi-structured, structured, and the least free problem-posing situations, in order from difficult to easy. It has been observed that when they start to practice the teaching profession, if they do problem-posing activities for their students, they give a positive or negative answer to the question asked if they make any preparations for this. Again, our teacher candidates answered the question in which order would you like to teach your students according to their problem-posing status while practising your profession.

The draft problem set identified categories such as "What stages did you go through?", "What did you look for?", "What features did you look for in the problem set?", and "What points did our prospective teachers look for in the answers?".When the answers to the questions of "Are the problem-posing process a useful process, what does it mean to you, what are your general thoughts about problem-posing, what are the benefits of the problem-posing process, what are the most repetitive answers?" Responses such as improving power are categorized. During the interviews, do you apply the problem-posing activity, which is asked in the sub-addition, to your whole class, and the students provided positive or negative feedback in response to the questions of whether they are more anxious while solving or posing problems.

2.5. Ethical

Ethical approval and written permission were obtained from the Educational Research Ethics Committee, Istanbul Sabahattin Zaim University (dated 14.04.2021 and number E.5449).

3. Findings

In this part, the findings obtained from the semi-structured interviews and the problems posed in the problem-posing outline were given.

The Findings Regarding Problem Posing Performances

The data obtained in the study show that prospective teachers created more successful problems in structured problem-posing situations than free and semi-structured problem-posing situations. The fact that prospective teachers are free to pose problems without constraints in free problem posing and are asked to pose problems according to certain patterns in semi-structured problem posing can be considered as a cause of more successful problem posing. It was found that each of the prospective teachers had asked three problems for structured problem setting. It was also found that some of the questions they had created for free and semi-structured problems did not have the characteristics of a problem or did not provide an answer.When we consider the evaluation criteria, it is seen that they tried to pose problems that are grammatically correct, understandable, related to the integers, suitable to the middle school level, and solvable problems. By considering the privacy issues, the names of the participants were stated through using codes. Prospective primary school mathematics teachers were numbered as T1, T2, T3, T4, T5, T6, T7, T8, T9, and T10. The frequency table of the scores obtained by prospective teachers for their posed problems as a result of their evaluation according to problem-posing criteria was given in Table 3.

Table 3. *The Scores of Prospective Teachers from Problem-Posing Situations*

Problem- Posing Types	Criteria	T1	T2	T3	T4	T5	T6	T7	T8	T9
F1	C1	1	1	2	1	1	1	1	1	2
	C2	1	2	1	1	1	1	1	1	2
	C3	1	1	1	2	2	1	2	2	2
	C4	2	1	2	2	1	2	2	2	2
	C5	2	2	2	2	2	2	2	2	2
	Total	**7**	**7**	**8**	**8**	**7**	**7**	**8**	**8**	**10**
F2	C1	0	1	0	1	1	1	0	1	1
	C2	0	1	0	1	1	1	0	1	0
	C3	0	2	0	2	2	1	0	2	0
	C4	0	1	0	2	1	2	0	2	1
	C5	0	2	0	2	2	2	0	2	1
	Total	**0**	**7**	**0**	**8**	**7**	**7**	**0**	**8**	**3**
F3	C1	1	1	1	2	1	1	2	2	1
	C2	1	2	1	1	1	1	1	2	1
	C3	0	1	0	0	0	0	2	0	0
	C4	2	2	2	2	2	2	2	2	2
	C5	2	2	2	2	2	1	2	2	2
	Total	**6**	**8**	**6**	**7**	**6**	**5**	**9**	**8**	**6**
SS1	C1	1	1	1	1	1	1	1	1	1
	C2	1	1	2	1	1	1	1	1	1
	C3	1	2	2	1	1	2	2	1	2
	C4	2	1	2	2	1	1	2	2	2
	C5	2	2	2	2	2	1	2	2	2
	Total	**7**	**7**	**9**	**7**	**6**	**6**	**8**	**7**	**8**
SS2	C1	0	0	0	0	1	0	0	1	1
	C2	0	0	0	0	1	0	0	1	1
	C3	0	0	0	0	1	0	0	2	1
	C4	0	0	0	0	2	0	0	2	2
	C5	0	0	0	0	2	0	0	2	2
	Total	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**8**	**7**
SS3	C1	1	2	2	1	1	1	1	1	1
	C2	1	2	2	2	1	1	1	2	2
	C3	1	2	2	2	2	1	2	2	2
	C4	2	2	2	2	2	1	2	2	2

	C5	2	2	2	2	2	2	2	2	2
	Total	**7**	**10**	**10**	**9**	**8**	**6**	**8**	**9**	**9**
S1	C1	1	1	1	2	1	1	1	1	1
	C2	1	1	1	0	1	1	2	1	1
	C3	1	2	2	2	1	2	1	2	2
	C4	2	2	2	2	2	2	2	2	2
	C5	2	2	2	2	2	2	2	2	2
	Total	**7**	**8**	**8**	**8**	**7**	**8**	**8**	**8**	**8**
S2	C1	2	1	1	1	1	1	2	2	1
	C2	2	1	2	1	1	2	1	2	1
	C3	0	2	2	2	2	2	2	1	2
	C4	2	2	2	2	2	2	2	1	2
	C5	2	2	2	1	2	2	2	2	2
	Total	**8**	**8**	**9**	**7**	**8**	**9**	**9**	**8**	**8**
S3	C1	2	1	1	1	1	2	2	1	1
	C2	0	2	1	1	2	2	2	1	1
	C3	0	1	2	2	2	1	1	2	2
	C4	2	2	2	2	2	2	2	2	2
	C5	2	2	2	2	2	2	2	2	2
	Total	**6**	**8**	**8**	**8**	**9**	**9**	**9**	**8**	**8**

F1= Free Problem-Posing 1, F2= Free Problem-Posing 2, F3= Free Problem-Posing 3; SS1= Semi-Structured Problem-Posing 1, SS2= Semi-Structured Problem-Posing 2, SS3 = Semi-Structured Problem-Posing 3; S1= Structured Problem-Posing 1, S2= Structured Problem-Posing 2, S3= Structured Problem-Posing 3; C1= Criteri1, C2= Criteri2, C3= Criteri3, C4= Criteri4, C5= Criteri5

Ten prospective teachers who study ied teaching mathematics in primary schools, completed teaching numbers class, and most importantly, had problem-posing training participated in our study. When creating the frequency table (by considering the fact that each teacher posed problems), the calculations were made over each problem as 3x10=30.

According to the frequency distribution of the scores obtained by the prospective teachers as a result of an evaluation according to the criteria for problem setting, 3 of the problems created for free problem setting were scored 0 because they had not posed a problem and had not answered the question "Write a problem you think is interesting about integers". 3 of the tasks created for free problem setting were scored 5 because they partially conformed to grammar rules and were partially understandable, had no relation to integers, but were solvable and suitable for intermediate level.Six of the problems created for semi-structured problem-posing situations got 0 points as they could not produce a problem from problem posing outline which was suitable to the given image. One of the problems got 4 points, and 2 of them got 6 points. The reason for this evaluation is because of the fact that they were not suitable to the grammar rules, not understandable, not related to integers, and not appropriate to the middle school level. Unsolved questions were coded as 4 points, and solvable questions were coded as 6 points.

In structured problem-posing situations, problems created obtained a maximum of 8 points. They could not get 10 points as they partly followed the grammar rules, and they contained clear and understandable problem statements. Since the researchers and two mathematics teachers who made the evaluation had a common view that the problems established in structured problem-posing situations were not written clearly and understandably, and the grammar rules were followed partly, they rated 18 of the problems as 8 points.

In terms of making a general evaluation, it is understood that there was one problem that got full 10 points since problems were created freely without having restrictions and without having a certain pattern in free problem-posing situations. On the other hand, 6 of the prospective teachers with great difficulty could not pose any problems since there were restrictions. They were asked to pose problems by giving equations, figures, and cards in semi-structured problem-posing situations. It was also understood from the frequency table that there were not any teachers who got full scores.

After the problems were evaluated following the evaluation criteria developed by the researchers, semi-structured interviews were conducted with the prospective teachers.

Findings obtained from Semi-structured interviews

Two teachers, T1 and T2, did not attend the semi-structured interviews due to their health problems. The answers obtained from the semi-structured interviews conducted with the prospective teachers were classified by using content analysis. An anxiety question was added to the interview questions after a pre-service teacher stated that she was worried while posing a problem during the semi-structured interview. The answers given were considered as one of the sub-dimensions of the third question. The classification of the prospective teachers' answers according to content analysis was shown in Table 4.

Table 4. *The Classification of the Prospective Teachers' Answers According to the Content Analysis*

Semi-structured interview questions	Deepening questions asked during the interview	Categorıes	Codes of prospectıve teachers
In which of the free, semi-structured, and structured problem-posing situations in the problem-posing outline did you have more difficulty?	If you rank, sort it from difficult to easy	Free-Structured-Semi-structured	T8
		Semi-structured-Structured-Free	T3,T5,T6,T10
		Structured-Semi-structured-Free	T4, T9
		Semi-structured-Free-Structured	T7
	Is it necessary to make any preparations before the problem-posing?	I got prepared beforehand	T3,T4,T5,T6,T7,T8,T10
		I did not get prepared.	T9
	When you are a teacher, which orders for giving the problem-posing situations will be useful for your students?	Free-Semi-structured-Structured	T6,T4,T10
		Semi-structured-Structured-Free	T3
		Structured-Semi-structured-Free	T7,T8,T9
		Semi-structured-Free- Structured	T5
What steps did you follow, and what did you pay attention to while posing a problem in the problem-posing outline?	What are the characteristics of the problems you created? What are the points you pay attention to?	Being logical	T3, T8, T9
		Being related to everyday life	T8, T10
		Having appropriate numbers	T3,T4,T5,T7,T8,T10
		Being authentic	T5, T10
		Being suitable to the grammar and spelling rules	T9, T10
		Being solvable	T3, T4, T10
		Having a short and understandable problem	T4, T6
		Being a new generation type of question	T5, T9
		Covering integers	T9
Do you think the problem-posing process is a useful process? What does it mean to you? What are your general opinions on posing problems?	What are the benefits of the problem-posing process?	Being helpful when preparing examinations	T3, T5
		Determining the extent of understanding regarding the topic	T3, T7, T8
		Being helpful to problem-solving	T3, T7, T10
		Having a different perspective	T4, T7, T8
		Being helpful to improve thinking	T7, T10
		Improvement of imagination	T4, T6, T10
	When you are a teacher, will you apply the problem-posing activity to the whole class?	I include all of my students	T3, T4, T9
		I do not practice problem-posing with the whole class	T5, T7, T8
	Do you think students are more anxious while posing or solving problems?	While posing problems	T3,T4,T6,T8,T10
		While solving problems	T5, T7, T9

As seen in Table 4, prospective teachers stated for the question about which problem situation challenged them most that they had difficulties posing problems for free-structured-semi-structured, semi-structured-structured, structured, semi-structured-free, and semi-structured –free-structured problem-posing situations, respectively. Thus, four different categories appeared, and the codes of the prospective teachers were given in the table.

During the interview, the researchers asked the prospective teachers, based on their responses, whether or not they needed preparation for problem-based instruction. From the responses, T9 did not prepare while the other prospective teachers needed preparation. The teacher coded as T8, who indicated that she would prepare, believed that it was necessary to know the topic and understand details to be able to pose problems, and that it was healthier to prepare beforehand to prepare students for the problem-setting process and to familiarise them with the topic.When the researcher asked the prospective teachers in what order they would use this process with their students if they were to use problem situations in the future as teachers, they indicated the order they would use with their students: free-semi-structured-structured, semi-structured-structured-free, structured-semi-structured-free, and semi-structured-free-structured, creating four categories.The second question given to the prospective teachers is, "*What steps did you follow, and what did you pay attention to while posing problems in the problem-posing outline*? And some of their answers were exemplified below.

> T8: *What I dislike when solving problems is to have unreasonable problems; I don't want to solve unreasonable problems. So I made sure that it makes sense when posing problems. I created problems by thinking about whether it is really happening in daily life within the framework of logic. Another issue I pay attention to is that the numbers are given in proportion. I thought if these numbers are appropriate for real life. For example, since the length of a young tree cannot be 5 meters, I paid attention to give it in centimeters.*

> T10: *I prepared a problem by considering it to be authentic and that the student had seen the problem style for the first time. I paid attention to having meaningful numbers to create problems that make students think differently, related to daily life and suggest different things. Sometimes we have to read the problem statement 5-10 times to understand it. We even read it over and over again from the very beginning. For this, I paid attention to the writing style. I tried to make a problem by calculating the numbers so that the results would be even numbers.*

> *T6: I made sure that the problem was understandable. I was careful to see if there was a way to solve it later. I think the numbers should match the problem.*

As for the last question in the interview form, when the prospective teachers were asked whether the process of problem setting is beneficial or not, what this process means, and what they think about the process of problem setting in general, the prospective teacher coded as T3 said, "I think problem setting helps us both in understanding other problems and in writing and taking exams when we become teachers in the future.*We can see the points that students have or do not have difficulties better, and I think it will be a useful process in this respect.*", the prospective teacher who coded T7 said, "*I think we can see how well we understand the issue while posing a problem. That's why I said I would show the student the latest free problem-setting situation. At first, we learn the subject, and then we create problems within the framework of certain boundaries and patterns. Finally, it helps us to improve our minds and find different points of view. It also enables teachers to work by themselves first to explain the subject, find something and then teach the subject. The problem is something similar to how mathematics teaches the subject. It shows how students have progressed and is a necessary activity"*. The answer of the prospective teacher who was coded as T10 is as the following "*I think problem-solving is very useful, but problem posing is more useful than that. First of all, you need to be able to solve problems well in order to create a problem. Then you need to have a good knowledge of mathematics. In order to write the questions, one must have Turkish grammar knowledge. It is necessary to write logical questions. Since the problem is a complex structure, it is necessary to have certain features. We do something while solving problems, but our brain develops even more because we do more than one thing while posing a problem. We are trying to expand our imagination as much as possible. While posing problems, we realize that we should have a wide imagination. As a result, we can orient ourselves as I would improve myself better in this area, and I would pose problems well if I knew this and that. In the future, I can make my students do some activities such as a problem-posing contest. There are too many question banks to meet this need, but we must create problems to improve." Finally, the prospective teacher with code T8 answered the question as follows: "Since my students will be used to my writing style, I want to ask a problem because I want to ask questions that I have prepared myself instead of taking advantage of another problem. I think problem-posing improves many skills. In the process of setting up a new generation problem, it is necessary to investigate the issues and create problems. Doing research and posing problems with correct information improves our general culture. We know more about the issues. That is why I want my students to have the problem-posing process. I think performance assignments should be given in this way. These assignments also cause the teacher to learn and develop new things. "*.

When the researcher asked prospective teachers whether they would employ problem-posing activities when they are teaching, T3, T4, and T9 stated that they would implement these activities with the whole class, and T5, T7, and T8 expressed that they would pay attention to the willingness of the students and instead of evaluating them with points as a compulsory task, they would give importance to carry out these activities with the volunteers for an expanded period of time.

While the interview with the teacher candidates was in progress, when the researcher asked whether the students were more anxious during the problem-posing process or if they experienced more anxiety while solving problems, the sample answers provided by prospective teachers are below.

> T9: *When we give a problem to a student, we highlight the number of right and wrong answers that he will make, so we put the student under stress while solving the problem. When we encourage the student to pose a problem, it will be more efficient if we think about how we can produce a problem by using student knowledge without grading.*

> T4: *When the problem is given to the students in a ready form, they focus only on the solution. When they create and solve the problem, they undertake two different responsibilities. When creating the problem, we should have foresight regarding the following steps, and we should move forward by correlating the solution to the problem. While preparing the problem, we try to create it by analysis and reasoning. While solving the problem, students only use the trial and error method once and use more than one method while creating the problem. They will both think to create the problem and think while solving the problem. They will be more concerned as they will have two responsibilities in creating the problem by themselves.*

> T5: *I think they become more anxious and worried when solving problems. When I give students a question in their exam, the problem has only one single answer, and the student has to find that correct answer. But when I ask him to pose a problem, after all, there are no one correct answers to the problem-posing. The problem can be created logically. The students can pose difficult or easy problems for themselves; they will write the problem they have created in their own minds. So I think they will have less anxiety when posing problems. They will be more anxious and worried as they will try to find the right answer in solving the given ready problem.*

4. Conclusion and Discussion

The study aims to analyze prospective teachers' problem-posing skills about integers and determine their opinions about the problem-posing process.

First of all, when the prospective teachers' problems were examined according to different situations, ten prospective teachers who participated in the study produced 30 new problems from all of the structured problem drafts given based on the structured problem-posing situation. It was determined that three prospective teachers did not write anything for three problems in case of free problem posing, and six prospective teachers did not write anything for six problems in case of semi-structured problems. In previous studies with prospective teachers, it was determined that their performance in problem posing was low (Özgen, Aydın, Geçici, & Bayram, 2017) The study conducted by Bayazit and Dönmez (2017) revealed that they were more successful in posing structured problems which appeared as a result of re-arrangement, but they did not have the same success with this study in terms of semi-structured and free problem-posing situations. This can be considered the limitation of prospective teachers by asking them to pose new problems based on the given problem in structured problem-posing situations and by asking them to produce problems from the given templates in semi-structured problem-posing situations. Işık and Kar (2012) stated that prospective classroom teachers could not produce new problems based on semi-structured problem-posing situations in their study. On the contrary, the result of Çetinkaya and Soybaş's (2018) research is more difficult in the free problem-posing process.

In examining the interviews with the trainee teachers who were found to be unable to write tasks for semi-structured assignments, it was evident that they had greater difficulty in setting semi-structured assignments where they had to set tasks according to a given number, they could not set free tasks as there were constraints and they had problems in understanding the given number. In line with this research, it was found that it was easier to set problems by making changes to the structured task or to create new problems by making changes to the given task compared to semi-structured and free tasks (Stickles, 2011). Some of the prospective teachers who created new problems from the problems given in structured problems stated that there was a plot in the given example problem and that it was easier to create a new plot by changing the numbers and event based on the given example question.As a result of the evaluation according to the problem-solving criteria established by the researchers, it was found that the problems did not arise due to the consideration of grammatical rules. When we examined the problems at the sentence level, it was determined that the problem statements were not clear and understandable, and the prospective teachers generally used daily spoken language. There are studies with different results on the success of using grammar rules correctly in problem posing. While Kanbur (2017) achieved successful results in using understandable sentence structure and grammar in problem-posing situations, Yıldız and Özdemir (2015) reached the opposite conclusion. Since the purpose of the Ministry of Education (2013) in Teaching Middle School Mathematics Curriculum is to make prospective teachers use everyday informal language rather than using mathematical language in their problems, this can be evaluated as a positive result.

Whether the problems related to integers or not were examined in the evaluation process. The majority of the created problems partially covered the subject of integers. One of the main factors that should be kept in the foreground in the problem-posing process is that the problems are solvable and whether they contain errors in terms of logic (Kırnap-Dönmez, 2014). Almost all the problems posed in this study were created according to the middle school level and the solvable structure. It was found that 90% of the problems were solvable. It was found that the reason why other problems could not be solved was due to the use of inappropriate numbers. Kılıç (2013) also came to similar conclusions as this study in her study.

Only one of the prospective teachers who wanted to teach problematic situations in their classes indicated that they would not make preparations for their students. The prospective teachers indicated the order in which they would use problematic situations in their teaching process in four different ways: free-structured-structured, semi-structured-structured-free, structured-structured-free, and semi-structured-free-structured. In the study conducted by İskenderoğlu and Guneş (2016), it was found that students had difficulty in problem-solving as teachers incorporated more problem-solving activities in their lessons. Since the use of problem-solving activities in the teaching process enables students to improve their mathematical understanding, prospective teachers are recommended to include these activities. (Stoyanova, 2003).The stages passed through in the task and the points to be considered by the prospective teachers are given below. The task may be related to daily life, be made within the framework of logic, conform to the original and new generation style of questioning, relate to the subject of whole numbers, and consist of suitable numbers.Also, the problems should be solvable. The problem should be short and understandable and be written by grammar and spelling rules. Problem posing is a way to make connections between daily life and mathematics and to improve mathematical thinking. (Abu Elwan, 1999). At the same time, problem-posing not only informs teachers about the areas that students are curious about and are interested in but also helps them determine how the subjects are understood by the students (Freire, 2018). Thus, teachers have the opportunity to look at their students' thinking styles from a window through problem posing (Çıldır & Sezen, 2011). In this direction, the expectation from teachers is to design learning environments using problem-posing activities from the perspective of their students (Aydın-Güç, 2021).

The prospective teachers indicated that when preparing for an exam, they do not use pre-made questions but create their own problems to determine how well the topic is understood by the students, to help the students solve the problems, to take a different perspective, to improve mentally, and to expand their imagination.When the researcher asks about the applicability of the problem-posing activity to every student in the classroom, three of the prospective teachers have the idea that problem-posing should be associated with mathematics. It would be healthier to produce the information presented instead of consuming the information presented since problem posing is a situation encountered in daily life and students need to produce solutions constantly. The other three prospective teachers stated that although the contribution of this process to the students would be great, not every student could do it at the same level when we consider the classroom environment, so this process should continue with the interested students. Having more problem-solving activities rather than problem-posing activities in lessons causes that students have fewer experiences in terms of problem-posing (Aydoğdu-İskenderoğlu & Güneş, 2016). Thinking that problem-posing activity will improve students' curiosity and imagination, Silver (1997) advocated that activities related to problem-posing should be done as much as possible. In the semi-structured interview, when one of the prospective teachers said that there was a fear of not being able to pose a good problem in the problem-posing process, a new question was asked to the prospective teachers. The researchers asked prospective teachers whether students will be more anxious when posing or solving problems. Five of the participants said when their anxiety levels rise when posing problems, and three participants said they become more anxious when they are solving problems. In the art of problem posing, Brown and Walter (2005) say that writing problems threaten students less than single-answer questions (p. 166). However, in this study, a prospective teacher stated that problem-posing creates more anxiety than problem-solving because she has to do problem-solving during problem posing.

5. Recommendations

The results of this study show that prospective teachers must improve their free and semi-structured problem-posing skills. When current studies are examined, it can be ensured that teachers develop their problem-posing skills through in-service training. By including more activities and elective courses that include problem posing in prospective primary school mathematics teachers' curriculum, their experience and skills for problem posing can be increased. Each week, they can be asked to create a problem related to a mathematical concept, and then these problems can be discussed in the classroom. Finally, their mistakes can be corrected. Problem-posing exercises can be carried out interactively with Turkish Language lessons, and problem statements can be discussed and examined in terms of having clear and understandable grammar rules. Just as problem-posing skills on integers are analyzed, researchers can examine problem-posing skills at different grade levels and in various topics of the mathematics course. Similar studies can be made based on problem-posing situations by establishing different evaluation criteria. Qualitative research can be conducted by examining the problem-posing skills of prospective teachers in-depth.

Another issue that attracts attention in the study is the feeling of anxiety that may arise during the problem-solving process. There are plans to study this topic in the future.

6. References

Abu-Elwan, R. (1999). *The development of mathematical problem posing skills for prospective middle school teachers.* In Proceedings of the International Conference on Mathematical Education into the 21st Century: Social challenges, Issues, and Approaches (Vol. 2, pp. 1-8).

Akay, H., & Boz, N. (2010). The effect of problem posing oriented analyses-II course on the attitudes toward mathematics and mathematics self-efficacy of elementary prospective mathematics teachers. *Australian Journal of Teacher Education*, *35*(1), 59-75.

Akay, H., Soybaş, D., & Argün, Z. (2006). Problem kurma deneyimleri ve matematik öğretiminde açık-uçlu soruların kullanımı [Problem-posing experiences and using open-ended questions in teaching mathematics]. *Gazi Üniversitesi Kastamonu Eğitim Dergisi, 14*(1), 129-146.

Akyazı, N., & Kaplan, A. (2018). İlköğretim altıncı sınıf öğrencilerine drama yöntemiyle tam sayılarla toplama işleminin öğretim sürecinin incelenmesi. *Bayburt Eğitim Fakültesi Dergisi, 13*(25), 259-294.

Altun, M. (2001). *Matematik öğretimi (İlköğretim ikinci kademede)* [Teaching mathematics (Middle schools)] Alfa.

Altun, M. (2006). Matematik öğretiminde gelişmeler. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi*, *19*(2), 223-238.

Arıkan, E. E., & Ünal, H. (2013). The analysis of mathematical problem posing skill of elementary second grade students. *Amasya Education Science*, *2*(2), 305-325.

Arıkan, E. E., & Unal, H. (2014). Development of the structured problem posing skills and using metaphoric perceptions. *European Journal of Science and Mathematics Education*, *2*(3), 155-166.

Arıkan, E. E., ve Dede, Y. (2020). Elementary freshmen's mathematical attitudes in teaching ıncorporating free problem posing activities. *Adıyaman Üniversitesi Eğitim Bilimleri Dergisi,* 10(2), 105-121.

Aydın-Güç, F. (2021). Matematik öğretmenlerinin geogebra ile çözülebilen problem kurma performansları. *Başkent University Journal of Education, 8*(2), 392-410.

Bağdat, A. G. O., & Yenilmez, K. (2014). Yedinci sınıf öğrencilerinin tam sayılarla işlemler konusundaki öğrenme güçlükleri.[Learning Difficulties of 7th Grade Students in operations with integers] *Avrasya Eğitim Araştırmaları Kongresi Bildiri Özetleri Kitapçığı,* 631-632.

Bahadır, E., ve Özdemir, A. Ş. (2013) Tam sayılar konusunun canlandırma tekniği ile öğretiminin öğrenci başarısına ve hatırlama düzeyine etkisi [The effect of teaching ıntegers subject with animation technique on student achievement and recall level]. *International Journal of Social Science Research,* 2(1), 114-136.

Bayazit, İ., & Dönmez, S. M. K. (2017). Öğretmen adaylarının problem kurma becerilerinin orantısal akıl yürütme gerektiren durumlar bağlamında incelenmesi [The analysis of prospective teachers' problem posing skills in the context of situations requiring proportional reasoning] *Turkish Journal of Computer and Mathematics Education, 8*(1), 130-160.

Bayraktar İ., (2020). *Online eğitim sitesi* [Online educational website] Erişim: 16 Aralık 2020. https://www.sanalokulumuz.com/tam-sayilar-problemler-7sinif-matematik/741

Berisha, V. (2015). The general characteristics of mathematics textbooks for lower secondary school in Kosovo. *International Journal of Novel Research in Education and Learning, 2*(2), 19-23.

Berkant, H. G., ve Yaren, R. (2020). Altıncı sınıf tam sayılar konusunda uygulanan gerçekçi matematik eğitiminin öğrencilerin matematik motivasyonlarına etkisi. *Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergisi, 17*(2), 543-571.

Bintaş, J. , & Yazgan, Y. (2005). İlköğretim dördüncü ve beşinci sınıf öğrencilerinin problem çözme stratejilerini kullanabilme düzeyleri: Bir öğretim deneyi [Primary school fourth and fifth grade students' levels of using problem solving strategies: A teaching experiment]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 28*(28), 210-218.

Brown, S. I., & Walter, M. I. (2005). *The art of problem posing*. Psychology Press.

Cai, J. & Hwang, S. (2020). Learning to teach through mathematical problem posing: Theoretical considerations, methodology, and directions for future research. *International Journal of Educational Research, 102,* 1-8.

Can, H. N. (2019). *Ortaokul matematik öğretmenlerinin kesirlerde işlemler konusu ıle ılgili pedagojik alan bilgilerinin öğrenci zorlukları ve kavram yanılgıları bileşeninde ıncelenmesi* (ınvestigation of secondary school mathematics teachers' pedagogical content knowledge related to the subject of fractional operations in the component of student difficulties and misconceptions) [Doctoral dissertation]. Marmara Universitesi.

Cihangir, A. ve Çevik, Y. (2020). Tam sayıların modellenmesine ilişkin durum çalışması [Case Study of modelling ıntegers]. *Necmettin Erbakan Üniversitesi Ereğli Eğitim Fakültesi Dergisi, 2*(2), 136-151.

Creswell, J. W. (2014). *Qualitative, quantitative and mixed methods approaches*. Sage.

Çetinkaya, A., & Soybaş, D. (2018). İlköğretim 8. sınıf öğrencilerinin problem kurma becerilerinin incelenmesi. *Journal of Theoretical Educational Science, 11*(1), 169-200.

Çıldır, S. & Sezen, N. (2011). A study on the evaluation of problem-posing skills in terms of academic success. *Procedia Social and Behavioral Sciences, 15,* 2494-2499.

Çıldır, S., & Sezen, N. (2011). Skill levels of prospective physics teachers on problem posing. *Hacettepe University Journal of Education Faculty, 40*, 105-116.

Dede, Y., & Yaman, S. (2005). Matematik öğretmen adaylarının matematiksel problem kurma ve problem çözme becerilerinin belirlenmesi [Determination of mathematical problem posing and problem solving skills of pre-service mathematics teachers] *Eurasian Journal of Educational Research (EJER)*, (18), 41-56.

Dereli, M. (2008). *Tam sayılar konusunun karikatürle öğretiminin öğrencilerin matematik başarılarına etkisi* [Yayınlanmamış yüksek lisans tezi]. Marmara Üniversitesi, İstanbul.

Doğan, M., & Işıtan, H. (2018). Gerçekçi matematik eğitiminin tam sayılar konusunda başarıya ve kalıcılığa etkililiği [Effectiveness of realistic mathematics education on success and permanence on ıntegers]. *Medeniyet Eğitim Araştırmaları Dergisi, 1*(4), 1-9.

Duatepe Paksu, A. (2010). Üslü ve köklü sayılar konularındaki öğrenme güçlükleri. *İlköğretimde karşılaşılan matematiksel zorluklar ve çözüm önerileri* [Learning difficulties in exponential and radical numbers. Mathematical difficulties encountered in primary education and solution suggestions]. Pegem.

English, L. D. (2020). Teaching and learning through mathematical problem posing: commentary. *International Journal of Educational Research, 102,* 101451.

Ev-Çimen, E., & Yıldız, Ş. (2018). Ortaokul matematik ders kitaplarında yer verilen problem kurma etkinliklerinin incelenmesi [Examining the problem-posing activities in middle school mathematics textbooks]. *Turkish Journal of Computer and Mathematics Education*, 8(3), 378-407.

Fraenkel, J. R., & Wallen, N. E. (2006). How to design and evaluate research in education. McGraw Hill.

Freire, P. (2018). *Bir özgürlük pratiği olarak eğitim* (pp. 396-398). Duke Üniversitesi Yayınları.

Fuadiah, N. F., Suryadi, D., & Turmudi, T. (2017). Analysis of didactical contracts on teaching mathematics: A design experiment on a lesson of negative ıntegers operations. *Infinity Journal, 6(2),* 157-168.

Galbraith, M. J. (1974). Negative numbers. *International Journal of Mathematical Education in Science and Technology, 5*(1), 83-90.

Gallardo, A. (2002). The extension of the natural-number domain to the integers in the transition from arithmetic to algebra. *Educational Studies in Mathematics, 49(*2), 171-192.

Gonzales, N. A. (1994). Problem posing: A neglected component in mathematics courses for prospective elementary and middle school teachers. *School Science and Mathematics, 94*(2), 78-84.

Gür, H. & Korkmaz, E. (2003). İlköğretim 7. sınıf öğrencilerinin problem ortaya atma becerilerinin belirlenmesi [Determining the problem posing skills of primary school 7th grade students]. *Matematikçiler Derneği Matematik Köşesi Makaleleri.*

Güzel, R., & Biber, A. Ç. (2019). Eşitsizlikler konusunun öğretiminde problem kurma yaklaşımının akademik başarıya etkisi. *Kastamonu Eğitim Dergisi*, *27*(1), 199-208.

Işık, A. Çiltaş, A., & Bekdemir, M. (2008). Matematik eğitiminin gerekliliği ve önemi [The necessity and importance of mathematics education]. *Atatürk Üniversitesi Kazım Karabekir Eğitim Fakültesi Dergisi, 17*, 174-184.

Işık, C. ve Kar, T. (2015). Altıncı sınıf öğrencilerinin kesirlerle ilgili açık-uçlu sözel hikayeye yönelik kurdukları problemlerin incelenmesi [Examination of sixth grade students' problems related to open-ended verbal stories about fractions]. *Turkish Journal of Computer and Mathematic Education (TURCOMAT), 6*(2), 230-249.

Işık, C. ve Kar, T. (2012). Sınıf öğretmeni adaylarının problem kurma becerileri. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi, 1(23)*, 190-214.

Ministry of National Education (2005). *İlköğretim matematik dersi 6-8. sınıflar öğretim programı ve kılavuzu* [Teaching program and guide for primary school mathematics, 6-8th grades]. Talim ve Terbiye Kurulu Başkanlığı, MEB Yayınları.

İpek, A. S. , & Ünal, Z. A. (2009). *Gerçekçi matematik eğitiminin ilköğretim 7. sınıf öğrencilerinin tam sayılarla çarpma konusundaki başarılarına etkisi* [The effect of realistic mathematics education on the success of elementary school 7th grade students in multiplying with integers]. *Eğitim ve Bilim Dergisi*, *34*(152).

İskenderoğlu, T. A., & Güneş, G. (2016). *Pedagojik formasyon eğitimi alan matematik bölümü öğrencilerinin problem kurma becerilerinin incelenmesi* [Examining the problem posing skills of the students of the mathematics department who receive pedagogical formation]. *Sakarya University Journal of Education, 6*(2), 46-65.

Kaba, Y., & Şengül, S. (2016). Developing the rubric for evaluating problem posing (REPP). *International Online Journal of Educational Sciences*, *8*(1), 8-25.

Kanbur, B. (2017). *İlköğretim matematik öğretmen adaylarının dinamik geometri yazılımı ile desteklenmiş ortamda problem kurma durumlarının ve görüşlerinin incelenmesi* [Yayınlanmamış yüksek lisans tezi]. Gazi University.

Kılıç, Ç. (2013). Pre-service primary teachers' free problem-posing performances in the context of fractions: An example from Turkey. *The Asia-Pacific Education Researcher, 22*(4), 677-686.

Kırnap-Dönmez, S. M. (2014). İlköğretim matematik öğretmen adaylarının problem kurma becerilerinin incelenmesi. *Unpublished master's thesis, Erciyes Üniversitesi Eğitim Bilimleri Enstitüsü, Kayseri.*

Kilhamn, C. (2008). Making sense of negative numbers through metaphorical reasoning. *GöteborgsUniversity. WW. mai. Liu. se/SMDF/madif6/Kilhamn.*

Kilpatrick, J. (1987). Problem formulating: Where do good problems come from. Cognitive science and mathematics education, 123-147.

Kiraz, K. Ş., & Işık, C. (2020). Tam sayıların öğretim sürecinin öğretmenlerin model kullanımları üzerinden analizi. *Bayburt Eğitim Fakültesi Dergisi, 15*(29), 81-108.

Koç Şanlı, K. (2018). *Ortaokul matematik öğretmenlerinin tam sayıların öğretim sürecinde model kullanma becerileri ve model kullanımına yönelik görüşleri* [Yüksek lisans tezi]. Erciyes Üniversitesi.

Kojima, K., Miwa, K., & Matsui, T. (2015). Experimental study of learning support through examples in mathematical problem posing. *Research and Practice in Technology Enhanced Learning, 10*(1), 1-18.

Kutluca, T. (2012) Matematiksel kavram yanılgıları ve çözüm önerileri [Mathematical misconceptions and suggestion]. *Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 18,* 287-291.

Kwon, H., & Capraro, M. M. (2021). Nurturing problem posing in young children: using multiple representation within students' real-world ınterest. *International Electronic Journal of Mathematics Education*, *16*(3), em0648.

Lin, P. J. (2004). *Supporting teachers on designing problem-posing tasks as a tool of assessment to understand students' mathematical learning*. International Group for the Psychology of Mathematics Education.

Linchevski, L., & Williams, J. (1999). Using intuition from everyday life in filling the gap in children's extension of their number concept to include the negative numbers. *Educational Studies in Mathematics, 39*(1), 131-147.

Ministry of National Education (MoNE) (2013). *Ortaokul (5-8. sınıflar) matematik öğretim programı* [Middle School (5th-8th grades) Mathematics Curriculum]. MEB Basımevi.

Miles, M. B., ve Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Sage.

Ministry of National Education (MoNE), (2008a). *Yetiştirici sınıf öğretim programı yönerge ve uygulanma kılavuzu* [Catch-up education program guidelines and application guide]. MEB Basımevi.

Ministry of National Education (MoNE), (2018a). *Matematik dersi (1-8. sınıflar) öğretim programı* [Mathematics Curriculum (1st-8th grades)]. MEB Basımevi.

Nixon-Ponder, S. (2001). *Using problem-posing dialogue in adult literacy education.* Retrieved September 1, 2018, from http://literacy.kent.edu/Oasis/Pubs/0300-8.htm

National Council of Teachers of Mathematics (NCTM) (2000). Standards for school mathematics, Reston, VA. *EE. UU.*

Özdemir, A. S., & Şahal, M. (2018). The effect of teaching integers through the problem posing approach on students' academic achievement and mathematics attitudes. *Eurasian Journal of Educational Research*, *18*(78), 117-138.

Özgen, K., Aydın, M., Geçici, M. E., & Bayram, B. (2017). Sekizinci sınıf öğrencilerinin problem kurma becerilerinin bazı değişkenler açısından incelenmesi. *Turkish Journal of Computer and Mathematics Education, 8*(2), 323-351.

Patton, M. Q. (1987). *How to use qualitative methods in evaluation* (No. 4). Sage.

Seng, K. L. (2010). An error analysis of form 2 (Grade 7) students in simplifying algebraic expressions: A descriptive study. *Electronic Journal of Research in Educational Psychology, 8*(1), 139-162.

Silver, E. A. (1994). On mathematical problem posing. *For the learning of mathematics*, *14*(1), 19-28.

Silver, E. A. (1997). Fostering creativity through instruction rich in mathematical problem solving and problem posing. *Adam*, *29*(3), 75-80.

Soylu, Y. ve Soylu, C. (2005). İlköğretim beşinci sınıf öğrencilerinin kesirler konusundaki öğrenme güçlükleri: kesirlerde sıralama, toplama, çıkarma, çarpma ve kesirlerle ilgili problemler [Fifth grade students' learning difficulties in fractions: ordering, adding, subtracting, multiplying in fractions and problems about fractions]. *Erzincan Eğitim Fakültesi Dergisi*, *7*(2), 101-117

Stickles, PR (2011). Ortaokul ve ortaokul öğretmenlerinin matematiksel problem pozlarının analizi [The Analysis of middle school teachers' mathematical problem poses] *Matematik Öğrenmede Araştırmalar*, *3*(2), 1-34.

Stoyanova, E. (2003). Extending students' understanding of mathematics via problem posing. *Australian Mathematics Teacher, 59*(2), 32-40.

Stoyanova, E., & Ellerton, N. F. (1996). A framework for research into students' problem posing in school mathematics. *Technology in mathematics education*, 518-525.

Wessman-Enzinger, N. M., & Tobias, J. M. (2020). The dimensions of prospective elementary and middle school teachers' problem posing for integer addition and subtraction. *Journal of Mathematics Teacher Education*, 1-33.

Yıldız, Z., & Özdemir, A. Ş. (2015). Hizmet öncesi ortaokul matematik öğretmenlerinin problem oluşturma yeteneklerinin analizi. *Uluslararası Online Eğitim Bilimleri Dergisi, 7(2).*