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Research Article

Story problems created by elementary mathematics teacher candidates in real-life situations: an algebra learning area example*

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Abstract

This research aims to examine the story problems of elementary mathematics teacher candidates in the field of algebra, which are suitable for real-life situations. For this purpose, it was tried to determine the pre-service teachers' preferred grade level, sub-learning area, and outcomes while creating a real-life story problem for the field of algebra learning. In addition, the relationship between story problems and outcomes, the reasons for choosing the grade level and sub-learning area, and the issues they paid attention to while creating the story problems are among the questions sought to be answered in the research. The research was designed according to the case study model. The study group the research consists of 35 elementary mathematics teacher candidates studying at the undergraduate level. 57% of the participants are female, and 43% male teacher candidates. In the study group selection, a non-random convenient sampling method was preferred. The algebra study instruction developed by the researchers was used as a data collection tool. In addition to the outcome(s) in the field of algebra learning, there are some questions that the participants should answer in the study guide. Descriptive and content analysis were used in the analysis of the data. According to the findings, most pre-service teachers were at the eighth-grade level, and inequalities created story problems suitable for a real-life situation related to the sub-learning domain. Pre-service teachers gave place to technology association in story problems. The pre-service teachers stated that they aimed to attract the students' attention and make them love mathematics while creating story problems. While creating the story problems, the most attention was paid to using actual data and originality. It has been suggested to increase pre-service teachers' awareness about the algebra learning field and encourage them to pose problems by the nature of their daily life situations.

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Introduction

In our century, problem-solving skills are considered important in mathematics and all other disciplines. When we look at the teaching methods of the twenty-first century, problem-solving is in the first place. Therefore, increasing success in problem-solving is a subject that many educators and psychologists have researched. The student can easily express their thoughts and reasoning in the problem-solving process and see the missing or empty parts in the mathematical reasoning of others (Ministry of National Education [MoNE], 2018). In this respect, problem-based teaching is considered

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necessary for student cognitive development. Mathematics is an effective problem-solving tool that helps people understand their environment (Baykul, 2016). The use of problems in mathematics has similar reasons, such as drawing attention to the subject, making students eager, and evaluating students (Posamentier & Krulik, 2016). In general terms, the concept of a problem is a complex or uncertain question. The problem is a matter of research, discussion, or thinking (Van de Walle et al., 2013). That is, problems are necessary and essential for mathematics and daily life (Yazgan & Arslan, 2017). Studies on elementary mathematics programs and standards for assessing mathematics outcomes emphasized developing mathematical problem-solving and reasoning skills. One of the primary goals is to use these skills in solving real-life problems. Problem-solving is very important for mathematics applications and other disciplines. Students must develop their problem-solving skills to understand mathematical processes, steps, and operations and use their mathematical skills (Polya, 1981). For this reason, students need to have sufficient problem-solving skills to become competent in the discipline they are interested in (Chapman, 2006). Thanks to the problem-solving skill, which is one of the skills that is frequently emphasized among 21st-century skills, the skills of individuals such as creativity, critical thinking, questioning, reflective thinking, scientific thinking, high-level thinking, reasoning, and decision-making are also developed (National Research Council [NRC], 2012). In this respect, problem-solving is considered one of the essential components of mathematics education and is both the aim of learning mathematics and the fundamental part of the learning process (Baykul, 2020; Jonassen, 2000; Williams, 2003). One of the skills planned to be acquired by individuals in the Ministry of National Education Mathematics Curriculum is that individuals are effective problem solvers (MoNE, 2018).

Problem-posing skills are just as critical as problem-solving. Problem posing is defined as generating a new question based on a situation or creating a new question by changing a problem (Silver, 1997). Problem-posing is an essential element of applied and abstract mathematics. In addition, problem-posing is a part of the mathematical modeling of real-life situations (Christou et al., 2005; NRC, 2012). It is strongly recommended to include problem-posing activities in mathematics curriculum and classroom teaching (Brown & Walter, 1993; Silver, 1997). The importance of the subject is also emphasized in national sources, and it is recommended that students work on problem-posing activities in the new mathematics curriculum (MoNE, 2018). The basic philosophy underlying these suggestions is that problem-posing activities allow the association of concepts and operational processes. In addition, problem-posing allows for establishing relationships between mathematics, other disciplines, and real-life. In addition to all its positive features, it is stated that problem-posing activities contribute to the development of students' creative and flexible thinking abilities and problem-solving competencies (NRC, 2012). It is also known that problem-posing paves the way for students to develop a more realistic idea about mathematics and allows them to reinforce and enrich their past knowledge (English, 1997).

While deciding the content of this research, studies in the literature were also examined. It has been seen in the literature that there are studies examining the problem-posing skills of students. Studies examining problem-posing competencies have shown that most students of all ages and education levels need to be more successful in problem-posing activities (Crespo & Sinclair, 2008; Dede & Yaman, 2005; Stickles, 2011). It has been determined that the students must be sufficient to create questions that involve creative and critical thinking and require knowledge transfer between subjects and disciplines. It has been reported that they create routine questions that can be solved by applying rote information and rules rather than quality problems (Crespo & Sinclair, 2008). In a different study, it was found that pre-service teachers had difficulties in creating new questions. It was stated that this inadequacy was due to the participants' inexperience in problem-posing and their lack of knowledge (Stickles, 2011). Crespo and Sinclair (2008) also examined the problem-posing competencies of teacher candidates. The results showed that most of the generated problems were routine problems related to formula usage. It was observed that very few participants could pose problems that required analysis and synthesis. Studies conducted in our country have also revealed similar results. For example, Korkmaz and Gür's (2006) study showed that high school mathematics and primary school teaching department students produced questions similar to the four operation problems in mathematics textbooks. In other words, in that study, it was stated that pre-service teachers could not display the mathematical thinking and reasoning skills expected of them. In another

study, it was seen that the participants were unsuccessful in problem-posing activities. It has been seen that the problems created are routine questions that contain quantitative data and are far from originality and creativity. Findings indicated that teacher candidates' inability to pose problems might be based on pedagogy (Bayazit & Kırnap-Dönmez, 2017). In another study conducted by Işık and Kar (2012), it was determined that the types of problems associated with different mathematical concepts and expressions given by students were limited, and problems that could be solved with simple calculations were preferred more. Students' performance in algebra learning is as essential as their problem-solving skills. Similarly, in the study by Dede and Yaman (2005), it was determined that pre-service mathematics teachers had difficulties in posing new problems based on the given problems and solutions. The study by Tekin-Sitrava and Işık (2018) concluded that the pre-service teachers who wrote verbal equations and could not pose any problems did not have sufficient content knowledge, problem-solving experience, and creativity skills. Algebra is the fundamental element of mathematics. In this respect, students' success in learning algebra profoundly affects mathematics and other fields. In addition to being a guide to understanding algebra problems, it is an effective communication tool to understand better and make sense of mathematics, an important subject area that performs actions on quantities, and a mathematical language that helps to understand symbolic representations (Akkaya & Durmuş, 2006; Kaput, 2008; Katz & Barton, 2007; Kieran, 2014; Lew, 2004; Stacey & MacGregor, 1999; Sutherland & Rojano, 1993). Therefore it is precious to make algebra more understandable and accessible for students (Kaput, 2008; Kieran, 2014). The findings of many studies in the related literature show that students have difficulties in understanding algebra (Akkan et al., 2017; Dede, 2004; Kar et al., 2011; Kaya, 2018; Kinzel, 2000; Stacey & MacGregor, 1999). The concepts in the algebra standard constitute the essential components of the school mathematics curriculum and help the concepts to be integrated (National Council of Teachers of Mathematics, [NCTM], 2000). However, the algebra learning field requires abstract thinking. In particular, having the expression unknown (variable) sometimes requires an understanding of abstract thinking in algebra because it contains expressions such as an equation and sometimes a figure, graph, diagram, table or picture.

Considering these inadequacies in problem posing, it is essential to carry out different studies and to provide training on this subject. It is known that education on problem-posing supports the development of pedagogical content knowledge and content knowledge (Silver, 1997). For this reason, including problem-posing activities in teacher education will contribute to the elimination of inadequacies in this regard. On the other hand, it may be beneficial for the training on this subject to include the skills to use the mathematical language effectively and to adapt the mathematical knowledge according to the student's cognitive levels. In this process, it is necessary to examine the characteristics and preferences of teacher candidates according to different variables to give practical problem-posing training. From this point of view, the researchers carried out this study. This study was planned to contribute to the literature and determine the problem-posing skills of teacher candidates in different subjects according to different variables. The field of algebra was chosen for this research on problem posing. Because no study has been found on this subject, this research aimed to examine the real-life story problems the elementary mathematics teacher candidates created for the field of algebra.

Problem of Research

This research aims to examine the story problems appropriate for real-life situations created by elementary mathematics teacher candidates for the field of algebra learning. The sub-problems of the research are as follows:

- What grade level, sub-learning area, and learning outcome(s) do pre-service teachers prefer while posing real-life story problems?
- What are the relationships between pre-service teachers' real-life story problems and the learning outcome(s)?
- What are the reasons why pre-service teachers prefer grade level and sub-learning areas?
- What points do pre-service teachers pay attention to when creating a story problem?

Method

Research Model

This research was designed in the case study model since it was aimed to examine the content of the story problems created by the elementary mathematics teacher candidates for the field of learning algebra. A case study is a methodological approach in which multiple data are collected to collect systematic information about how a limited system works (Chmiliar, 2010). Merriam (2013), on the other hand, defines a case study as an in-depth description and examination of a limited system. In short, the case study is a qualitative research approach in which the researcher examined one or more limited cases over time with data collection tools (observation, interviews, audio-visuals, documents, reports) that includes multiple sources and the themes related to the case(s) are defined (Creswell, 2018).

Participants

The study group of the research consists of 35 elementary mathematics teacher candidates studying at a state university at the undergraduate level. 20 (57%) of the participants are female, and 15 (43%) are male students. In the study group selection, the non-random convenient sampling method was preferred. Among the reasons for choosing this way are that the sample to be applied is studying in the mathematics education department of the university where the researcher is working, the ease of access to the sample, and the ease of time and labor. Appropriate sampling method; The sample is chosen from easily accessible and functional units due to limitations in terms of time, money, and labor (Büyüköztürk et al., 2018). Before the research was conducted, the participants were given detailed information about the content of the study. Participation in the research was based on volunteerism.

Data Collection Tools

In the study, a study guide prepared by the researchers for the field of algebra learning was used as a data collection tool. The opinions of the assessment and evaluation expert and the field expert were also taken in creating the content of the study directive. In this way, internal validity was tried to be ensured in preparing the study instructions. In the preparation of the study guide, first of all, the relevant literature was scanned, and the data collection tools and processes of studies conducted in a similar direction were carefully read (Akkan et al., 2019; Bayazit & Kırnap-Dönmez, 2017; Gainsburg, 2008; Güner, 2021; Güner & Erbay, 2021; Işık & Kar, 2012; Korkmaz & Gür, 2006; Lee, 2012; Özgeldi & Osmanoğlu, 2017; Özgen et al., 2017). In the study guide, which was prepared with the support of the literature, there are some topics the participants should answer and points to which the participants should pay attention. The study directive includes the outcomes at the sixth, seventh and eighth grades in the algebra learning field in the mathematics curriculum. Since there is no algebra learning area in the mathematics curriculum at the fifth-grade level, the outcomes at the sixth, seventh and eighth-grade levels were included in the study (MoNE, 2018). There are algebraic expressions at the sixth-grade level, algebraic expressions, equality and equations at the seventh-grade level, and algebraic expressions and identities, linear equations, and inequalities at the eighth-grade level (see Appendix-1). The headings in the study guide are as follows: (i) grade level, (ii) sub-learning area, (iii) outcome(s), (iv) why this grade level and the sub-learning area is preferred, (v) when creating story problems what is paid attention to and (vi) creating the story problem appropriate to the daily life situation. In the study, the names of the prospective teachers were kept confidential, and the study instructions were coded as TC1, TC2, TC3...TC35. In addition, to avoid bias, the answers given by the participants were given codes and reported in the findings section.

Analysis of Data

Qualitative data analysis was used to analyze the data in the research. Qualitative data analysis is an exploratory process, and in this process, the researcher organizes, classifies, synthesizes, draws patterns, reaches concepts, and reports the findings (Gürbüz & Şahin, 2016). In this study, the documents belonging to the problems that the students posed about the learning field of algebra were analyzed, and the obtained data were presented under specific categories. The data obtained from the problem-posing practices were analyzed with descriptive and content analysis methods. Descriptive analysis is analytical approach that includes the steps of processing qualitative data, defining the findings, and

interpreting the identified findings depending on a predetermined framework (Yıldırım & Şimşek, 2018). Content analysis, on the other hand, requires an in-depth analysis of the collected data and allows the revealing of previously themes and dimensions (Yıldırım & Şimşek, 2018). Before proceeding to the data analysis, the researchers read the documents consisting of the data set several times. After this stage, first of all, the problems posed by the pre-service teachers in the real-life situation were examined by making content analysis. The content analysis aims to reach concepts and relationships that can explain the collected data. In another step, the percentages of preference (class, sub-learning domains, and outcome(s)) of previously given outcomes according to grade levels were evaluated with the help of descriptive analysis. While the outcomes are coded in the tables, they are specified as grade level, learning area, sub-learning area, and acquisition number, respectively. For example, the code [6.2.1.1] was used to acquire "writes an algebraic expression suitable for a verbally given situation and a verbal situation suitable for a given algebraic expression," which is included in the algebraic expressions sub-learning of the sixth-grade algebra learning domain. The order of the mathematics curriculum outcomes was considered in the formation of this code (MoNE, 2018).

Results

In this part of the research, the findings obtained in line with the sub-problems of the research are included. In this context, the story problems created by the participants by the actual life situation, grade level, sub-learning area, and learning outcomes were examined. Afterwards, the relationships between the story problems and the outcome(s) suitable for the real-life situation of the pre-service teachers were examined. In the other step, the reasons for preferring the pre-service teachers' grade level and sub-learning area were evaluated. Finally, the points that pre-service teachers paid attention to while creating a story problem were determined and reported. In this direction, what are the grade level, sub-learning area, and outcome(s) preferred by the pre-service teachers? Which is the first sub-problem of the research when creating story problems suitable for real-life situations? The findings regarding the problem are presented in the table below (Table 1).

Table 1. The story problem preferences of the participants appropriate to the real-life situation

Grade Level	Sub-Learning Area	Outcome Code	*f* (%)
6. Class	Algebraic Expressions	6.2.1.1	2 (%4.5)
		6.2.1.2	2 (%4.5)
7. Class	Algebraic Expressions	7.2.1.1	2 (%4.5)
		7.2.1.2	2 (%4.5)
		7.2.1.3	2 (%4.5)
	Equality and Equation	7.2.2.1	2 (%4.5)
		7.2.2.2	2 (%4.5)
		7.2.2.3	2 (%4.5)
		7.2.2.4	4 (%9.1)
8. Class	Algebraic Expressions and Identities	8.2.1.2	1 (%2.3)
		8.2.1.3	1 (%2.3)
	Linear Equations	8.2.2.1	2 (%4.5)
		8.2.2.2	1 (%2.3)
		8.2.2.3	1 (%2.3)
		8.2.2.5	4 (%9.1)
	Inequalities	8.2.3.1	7 (%16.0)
		8.2.3.3	7 (%16.0)

Note: There are studies in which more than one outcome is preferred

When Table 1 is examined, it was seen that the pre-service teachers preferred the eighth-grade level more while creating a real-life story problem related to the learning field of algebra. Especially at the eighth-grade level, inequalities created more story problems related to sub-learning. In addition, more story problems were created with linear equations in the eighth-grade and the sub-learning areas of equality and equations in the seventh-grade. The least preferred grade level was the sixth-grade level. The findings, which include the relationship between the story problems that the pre-service teachers set up in real-life about the algebra learning field and the achievements, are presented in the table below (Table 2).

Table 2. Relationships between real-life story problems and outcome(s)

Grade Level	Outcome Code	Story Problem Fiction
6. Class	6.2.1.1	Coins in the Piggy Bank (TC1) (Savings/Finance)
		Walnut Account (TC10) (Food)
	6.2.1.2	Height Growth (TC25) (Physical Development)
		Bone Age-Length (TC35) (Physical Development)
7. Class	7.2.1.1	Sapling Growth (TC34) (Plant Science)
		Computer Game (TC12) (Technology)
	7.2.1.2	Why Are Honeycombs Hexagonal? (TC7) (Animal Science)
		Erosion (TC11) (Natural Phenomenon)
	7.2.1.3	Fishing Boat (TC21) (Commercial)
		Paper Consumption (TC31) (Consumption)
	7.2.2.1	Well (TC22) (Human-Drilled Pit)
		Feast of Sacrifice (TC19) (Religious Feast)
	7.2.2.2	Paper Consumption (TC31) (Consumption)
		Bank Account (TC24) (Finance)
	7.2.2.3	Paper Consumption (TC31) (Consumption)
		Metaverse (TC16) (Technology)
		Video Watch Time (TC17) (Technology)
		Cinema Ticket (TC30) (Art)
	7.2.2.4	Local Election (TC29) (Politics)
		Bookcase (TC26) (Carpenter)
8. Class	8.2.1.2	EuroLeague Basketball Tournament (TC4) (Sports)
		Battery Health (TC13) (Technology)
		Telephone Billing Tariff (TC2) (Technology/Savings)
		Endemic Study (TC6) (Plant Science)
	8.2.1.3	Can people with a license drive all vehicles? (TC28) (Official Document)
		Obesity (TC14) (Health)
		Water Bill (TC33) (Finance)
		Drone (TC27) (Technology)
		Water Consumption (TC15) (Consumption)
		Construction Machinery Rental (TC9) (Commercial)
		Speed Limit (TC32) (Rule)
	8.2.2.1	Water Bill (TC33) (Finance)
		Poplar Tree (TC18) (Plant Science)
		Construction Machinery Rental (TC9) (Commercial)
		Pocket Money (TC3)
	8.2.2.2	Cake Making (TC23) (Recipe)
	8.2.2.3	Receiving a Gift (TC5) (Special Day)
		Telephone Billing Tariff (TC2) (Technology/Savings)
	8.2.2.5	Land Parceling (TC8) (Part of Earth)
	8.2.3.1	Darts Tournament (TC20) (Tournament)
	8.2.3.3	Telephone Billing Tariff (TC2) (Technology/Savings)

Note: There are studies in which more than one outcome is preferred

When Table 2 is examined, the pre-service teachers mainly focused on the co-existence of technology and daily life while creating real-life story problems related to learning algebra. Pre-service teachers focused more on the daily life situations of mobile phones, drones, video, virtual world, and computer games in technology-related story problems. In addition, there are financial, health, savings, physical development, consumption, plant and animal science, special days

and people, rules (traffic rules), sports (tournaments, etc.), water consumption, and commercial and artistic story problems. Examples of real-life appropriate story problems that pre-service teachers have set up in the field of learning algebra are presented below.

> *According to a study based in the United States, people spend about 6 hours a day watching videos. Based on this result, we spend a lot of time watching videos. Thanks to the plug-in called "Video Speed Controller," you can adjust your time management by speeding up or slowing down the videos you watch during the day. Application controls are implemented very simply. Namely: The "X" key fast forwards the video we are watching by 10 seconds. The "Z" key rewinds the video we watch for 10 seconds. The "R" key increases the acceleration value of the video we watch by 0.4x. The "E" key increases the acceleration value of the video by 0.1x. The video acceleration value is initially fixed at "1.00x". The working principle of the application is simple. For example, if you want a video at 2.00x speed, then the player plays a two-second video in one second due to the value of 2.00x. Ali and his friend Kemal are watching videos using the application with the above features. When Ali starts watching the same video simultaneously, he presses the "x" key six times and the "R" key five times. Kemal, on the other hand, did not press the "x" and "z" keys; instead, he pressed the "R" critical 15 times. If Ali finished the video 10 seconds before Kemal, how long was the video they watched? (TC 17).*

> *Water consumption is of great importance for a person to continue his life. According to the general guidelines of scientific organizations, it is stated that a healthy adult should consume at least 35 ml of water per kilogram of water per day. Water consumption helps individuals lose weight healthily, balance the metabolic rate, and prevent mineral loss in the body. How many liters of water do you consume per day? What is your weight? Can you calculate and express the amount of water consumption expressed according to the data of scientific organizations in direct proportion to your weight?... (TC15).*

> *Beeswax production is a very energy-intensive process for bees. Bees use the hexagon as the most suitable honeycomb shape to do this process, which requires energy most easily and robustly. This shape is ideal for storing the most honey with less material. Do you know how bees make honey? If honeycombs were not hexagons, what shape would they be? Why? (TC7).*

In another step of the research, the reasons for the pre-service teachers' choice of grade level and sub-learning area were evaluated. Accordingly, the reasons that stand out from the answers of the pre-service teachers on the answer sheets are listed in the table below (Table 3).

Table 3. Reasons of participants preferring story problems

Reason for Preference	***f* (%)**
Attract students' attention	25 (%71.4)
Making students love math	23 (%65.7)
To be fun and intriguing	22 (%62.8)
Because it is learning that students have difficulty with	20 (%57.1)
As it forms the basis of other outcomes	15 (%42.8)
Because they are familiar with this outcome according to other outcome and grade level	13 (%37.1)
Because it allows more possibilities for multiple impressions	10 (%28.5)
Since the selected class level has preliminary information	9 (%25.7)
To avoid misconceptions	5 (%14.2)
Because it allows for more concretization	4 (%11.4)
Because it allows modeling	3 (%8.5)
Other reasons (more gains, lack of rote learning, etc.)	3 (%8.5)
8^{th} graders will attend high school entrance exam and because there are so many questions about this subject	2 (%5.7)
No idea	1 (%2.8)

Note: There are studies in which more than one reason is presented

When Table 3 is examined, the pre-service teachers mostly set up real-life story problems with the thought that they would attract students' attention, make the love of mathematics, and be entertaining and intriguing. In addition, the fact that it is the learning area that students have the most difficulty with, and it forms the basis of other acquisitions, pre-service teachers' pre-dispositions, providing more opportunities for multiple demonstrations, and having prior knowledge of the chosen grade level are among the other reasons why pre-service teachers create story problems. The pre-service teachers' answers were to avoid misconceptions, make concretizations and model, and because the students took the exam at the end of the year, they preferred this story problem. The points that the pre-service teachers paid attention to while creating the story problem, which is another sub-problem of the research, are presented below in the form of a word cloud.

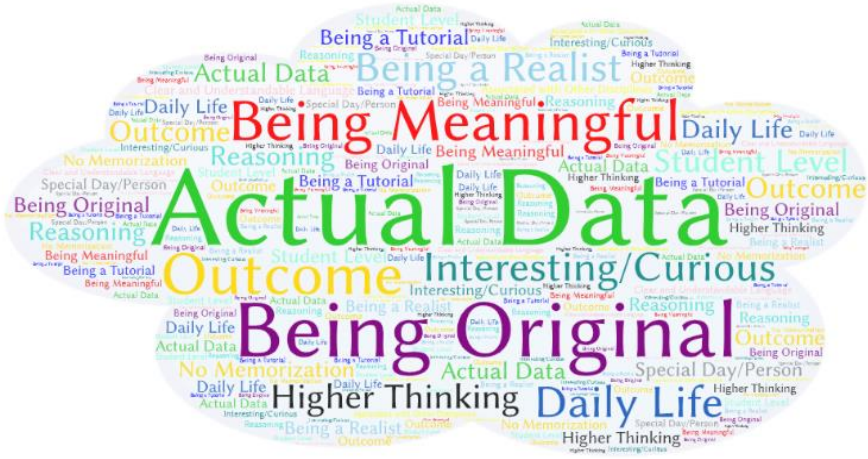

Figure 1. Considerations while creating the story problem

When Figure 1 is examined, it can be seen that the pre-service teachers use actual data (n=28), original (n=22), meaningful (n=21), achievements (n=20), compatible with daily life while creating story problems suitable for real-life situations. (n=19), realistic (n=18), interesting, attractive, and intriguing (n=15), high-level thinking skills (n=11), precise and clear (n=9), instructive (n=8), requiring reasoning (n=5), not being memorizing (n=3), being related to other disciplines (n=2), including special days and people (n=1).

Discussion and Conclusion

Within the scope of this research, the pre-service teachers' story problems set up by the actual life situation in the field of learning algebra were examined. In this context, pre-service teachers mostly preferred outcomes at the eighth-grade level while posing real-life story problems. At least the pre-service teachers posed a story problem in the eighth and sixth grades. Inequalities, linear equations, equality, and equation sub-learning areas come to the fore in the preferences of pre-service teachers in story problems. It is noteworthy that they set up more story problems related to the inequalities sub-learning domain. Among the most important reasons for this situation it can be shown that the subject of inequalities is more difficult for students to learn. Another reason is that eighth graders will take the entrance exam to high schools because questions about the field of algebra learning take an important place in the entrance exam to high schools. It has been determined that the pre-service teachers pay attention to the fact that the students have the necessary pre-knowledge about learning algebra to pose more story problems at the eighth-grade level. There are fewer acquisitions related to algebra learning in the mathematics curriculum, and the number of acquisitions increases as the grade level increases. Therefore, as the grade level of the student's increases, the intensity of their relationship with algebra also increases. This situation may have caused pre-service teachers to be more interested in the eighth-grade level while creating story problems. Considering the higher number of sub-learnings and the diversity of achievements, most pre-service teachers preferred the eighth-grade level. Creating more story problems, especially in the inequalities and linear equations sub-learning areas, can be the most substantial evidence of this situation.

Due to its structure, algebra requires abstract thinking (Stacey & MacGregor, 1999). At the same time, algebra is one of the essential fields of study in many disciplines, and being able to express ideas is an essential component of its nature. Algebra is an important field of study that should be known for using mathematical language effectively (Lew, 2004; Sutherland & Rojano, 1993). Algebra supports reasoning and plays an essential role in transforming numbers and symbols into equations (Akkaya & Durmuş, 2006; Katz & Barton, 2007). These strengths of algebra were also reflected in the pre-service teachers' story problems. It is seen that pre-service teachers also consider the student's prior knowledge in their preferences in story problems related to algebra learning. The findings of many studies in the related literature show that students have difficulties and difficulties in understanding algebra (Akkan et al., 2017; Dede, 2004; Kar et al., 2011; Kaya, 2018; Kinzel, 2000; Stacey & MacGregor, 1999).

Pre-service teachers also tried to present a different perspective on inequalities by posing more story problems about inequalities, one of the sub-learning areas where students have the most difficulty in algebra. It is known that there are problems both in teaching and in students' learning about inequalities (Çoban & Yenilmez, 2020). Therefore, the fact that the pre-service teachers gave more place to this subject in the content of the story problems shows that the pre-service teachers are also aware of the problems experienced in teaching inequalities. Another finding is that the pre-service teachers set up many real-life story problems for the seventh-grade level equality and equation sub-learning domain. The past learning experiences of the pre-service teachers can be shown as the reason for the tendency of the pre-service teachers at this grade level. The construction of the contents of the pre-service teachers' story problems is similar to the problems in the mathematics textbooks. In this context, while students are creating story problems, they are generally influenced by the textbooks and the situations that often occur in their lives. This finding shows parallelism with the result of a similar study in the literature (Korkmaz & Gür, 2006). In addition, there are study findings in the related literature that the story problems created by the students primarily reflect the content of the textbooks and consist of problems that do not include creativity (Bayazit & Kırnap-Dönmez, 2017).

Another study finding was that pre-service teachers prioritized combining technology and real life in story problems. Pre-service teachers gave space to technology-related information, which has an important place in our lives, in story constructions. Although this finding is an expected result, it also emphasizes the place of technology in our lives. Pre-service teachers discussed situations we frequently encounter daily, such as mobile phones, drones, videos, virtual worlds, and computer games. Considering the place of mobile phones and computers in our lives, it was inevitable that this situation would reflect on the problems of teacher candidates. However, although there are many tendencies to story problems related to technology, this number is not enough. Because considering the number of the participant group, it is seen that the number of technology and technology-related story problems is limited. Examining the findings of similar studies, it is noteworthy that students are not successful enough in problem-posing activities, are insufficient in knowledge transfer questions, and form questions based on rote (Crespo & Sinclair, 2008; Dede & Yaman, 2005; Stickles, 2006). In the findings of the study conducted by Işık and Kar (2012), it was determined that pre-service teachers preferred more problems that could be solved with simple calculations. Pre-service teachers' content knowledge, problem-solving experience, and creativity skills are essential to pose a good problem (Tekin-Sitrava & Işık, 2018). In addition to these, physical development (height growth, weight gain, etc.), finance/savings, food, plant and animal science (sapling, poplar, bee, etc.), natural events (erosion), consumption (paper and water consumption, etc.), Pre-service teachers also created story problems on religious holidays, art, politics (local elections), sports (basketball, darts, etc.), health (obesity) and rules (traffic rules).

Another finding from the research was the reasons why pre-service teachers preferred story problems. Pre-service teachers stated that they mostly acted to attract the students' attention while creating the story problems. It was stated that endearing mathematics and being intriguing are characteristic features of story problems. In addition, pre-service teachers' dispositions, being the basis of other acquisitions, subjects that students have difficulty with, allowing multiple demonstrations, lack of prior knowledge of the selected class, and allowing modeling are among the other reasons for their preference. At this point, pre-service teachers need to have problem-posing skills. In the study conducted by Dede

and Yaman (2005), it was reported that students had difficulties posing new problems and that problem-posing was a critical skill component. The last finding of the study was obtained from the points that pre-service teachers paid attention to while creating story problems suitable for real-life situations. Accordingly, pre-service teachers paid attention to using actual data, originality, meaningfulness, achievements, compatibility with daily life, realistic, interesting, attractive, and intriguing while posing story problems. In addition, other issues were considered to include high-level thinking skills, being understandable and transparent, being instructive, requiring reasoning, not being memorized, being related to other disciplines, and including special days and people. While creating the story problems of the pre-service teachers, they generally tried to keep concretization in the foreground. It is emphasized that giving mathematical concepts to primary school students as concretely as possible will enable them to learn and understand advanced mathematical concepts (Akkan et al., 2017).

Recommendations

By increasing pre-service teachers' awareness about the field of learning algebra, they can be encouraged to pose problems appropriate to the nature of their daily life situation. In this study, the problem-posing skills of pre-service teachers in learning algebra were examined. Teachers' skills on this subject can be examined in future studies. In addition, pre-service teachers can be asked to pose more problems related to the learning area, problem-solving strategies, process skills, and contexts they prefer less, so they have a more comprehensive range of problem-posing skills. Within the scope of the study, only one learning area was considered. Therefore, similar studies can be conducted on learning areas in all grades (5, 6, 7, 8) in the mathematics curriculum. In addition to the story problem preferences of teacher candidates, the relationships between learning styles can be discussed and examined in depth. Problem posing is a situation that has an important place, especially in mathematics education, and requires expertise. In this regard, teacher candidates can be trained in this direction, and the content of elective courses can be arranged in this direction. In the study, which was designed by a real-life situation, only the learning areas and the achievements in these learning areas were given to the participants. In studies to be carried out in a similar direction, verbal problem sentences or equations may be given. They may be asked to set up story problems suitable for daily situations.

Limitation of Study

The most important limitation of the study is that only the algebra learning area is included in creating story problems. The algebra learning area in the mathematics curriculum is at the sixth, seventh, and eighth-grade levels. There is no algebra learning area at the fifth-grade level. Therefore, the sub-dimensions of the algebra learning field are limited to the sixth, seventh and eighth-grade levels. Another limitation of the study is the participation of volunteer students. The content of the story problems written by the students who did not want or could not participate in studying the real-life situation may vary. In addition, the study was carried out with undergraduate students in the last year. The story problems related to the algebra learning domain of students at different grade levels may also vary.

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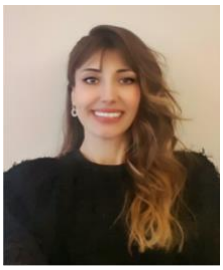

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Appendix-1: Mathematics Curriculum Algebra Learning Area Outcomes

Grade 6 Algebra Learning Field

Sub-Learning Area: Algebraic Expressions

6.2.1.1. Writes an algebraic expression suitable for a verbally given situation and a verbal situation suitable for a given algebraic expression.
6.2.1.2. Calculates the value of the algebraic expression for the different natural number values that the variable will take.
6.2.1.3. Explain the meaning of simple algebraic expressions.

Grade 7 Algebra Learning Field

Sub-Learning Area: Algebraic Expressions

7.2.1.1. Performs addition and subtraction operations with algebraic expressions.
7.2.1.2. Multiplies an algebraic expression by a natural number.
7.2.1.3. Expresses the rule of the number patterns with a letter and finds the desired term of the pattern whose rule is expressed with a letter.

Sub-Learning Area: Equality and Equation

7.2.2.1. Understand the principle of conservation of equality.
7.2.2.2. Recognizes an equation with a first-order unknown and establishes an equation with a first-degree unknown by given real-life situations.
7.2.2.3. Solves first-order equations with one unknown.
7.2.2.4. Solves problems that require establishing an equation with a first-order unknown.

Grade 8 Algebra Learning Field

Sub-Learning Area: Algebraic Expressions and Identities

8.2.1.1. Understands simple algebraic expressions and write them in different formats.
8.2.1.2. Multiplies algebraic expressions.
8.2.1.3. Explain identities with models.
8.2.1.4. Factors algebraic expressions.

Sub-Learning Area: Linear Equations

8.2.2.1. Solves first-order equations with one unknown.
8.2.2.2. It recognizes the coordinate system with its properties and shows ordered pairs.
8.2.2.3. Expresses how one of the two variables that have a linear relationship between them changes depending on the other, with a table and an equation.
8.2.2.4. Draws the graph of linear equations.
8.2.2.5. Creates and interprets equations, tables, and graphs of real-life situations with linear relationships.
8.2.2.6. Explain the slope of the line with models, and relate linear equations and graphs with the slope.

Sub-Learning Area: Inequalities

8.2.3.1. Writes mathematical sentences suitable for daily situations involving inequality with a first-degree unknown.
8.2.3.2. Represents inequalities with a first-order unknown on the number line.
8.2.3.3. Solves inequalities with a first-order unknown.