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THE CONNECTION OF MATHEMATICS WITH REAL-LIFE SITUATIONS: PRESERVICE ELEMENTARY MATHEMATICS TEACHERS' PERCEPTIONS OF CREATING AND EVALUATING STORY PROBLEMS

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Abstract

This study aimed to determine the perceptions of preservice elementary mathematics teachers about creating and evaluating real-life connections in story problems. The study was conducted according to the case design. The study group consists of 35 preservice teachers taking Mathematical Connection Teaching course. Study instruction was used as a data collection tool. While analyzing the data, content analysis and the codes of similar studies were used. According to the findings, real-life problem preferences of the teacher candidates are generally about numbers and operations learning domain at the seventh-grade level. Preservice teachers' aim while creating story problems is to show students how to use them in real-life and to create awareness. The preservice teachers mostly paid attention to the suitability of the student and grade level while creating problems. While preservice teachers' real-life associations were predominantly in the form of examining accurate data, only one study met the evaluation criteria. Most preservice teachers thought that the story problems could be associated with real-life situations. Consequently, it was determined that the preservice teachers found the reflection of real-life situations in the story problems useful for students, and the mathematics subjects can be associated with real-life situations.

Keywords: Evaluation perception, preservice teacher, real-life connection, story problem.

INTRODUCTION

In a changing and constantly renewing world, instead of taking the information as it is, internalizing it by processing and transferring it to daily life situations has become the primary purpose. In line with this purpose, in the perspective of the curricula of many countries, raising individuals who can understand the concepts and use these concepts in their daily lives by evaluating knowledge, skills, and behavior as a whole has taken its place among the main objectives of the curricula (Eurydice, 2012; Ministry of National Education [MoNE], 2018; National Council of Teachers of Mathematics [NCTM], 2014; National Research Council [NRC], 2011). For this reason, reaching the correct knowledge, understanding this knowledge, producing new and different types of knowledge, interpreting the produced knowledge, attributing meaning to the knowledge, adapting the acquired knowledge to daily life situations, and using it effectively are the roles attributed to individuals by today's information societies. Undoubtedly, one of the most effective ways of internalizing the knowledge reached is associating them with real-life situations (Kösece, 2020). Especially knowing that the information learned in the school and classroom environment has an equivalent in daily life makes it easier for the learner to internalize the information and use it when needed. Thus, today's education systems focus on teaching students how to reach information instead of transferring the existing information (MoNE, 2018; NCTM, 2000). The most important reason for this is that

individuals who can produce solutions for daily life problems, transfer the acquired knowledge to daily life situations, and make sense of them by turning them into skills are needed more than ever (Arthur et al., 2018; Bukova Güzel et al., 2018; Chapman, 2012; English & Watters, 2004; MoNE, 2018; Mutlu & Akgün, 2016; NCTM, 2000; Özgen, 2013a).

Mathematics is one of the most critical disciplines contributing to a better understanding of the world. Mathematics lessons are not only about the theoretical information used within the classes but also an important field of study that provides practical solutions to the problems encountered in daily life and helps them cope with the issues (NCTM, 2014). In this respect, raising individuals equipped with mathematical knowledge and skills and allowing them to produce solutions to the problems they encounter in their real lives are among the elementary goals of mathematics education (MoNE, 2018). Freudenthal (1991) stated that exploring mathematics and using it effectively is necessary to associate mathematics with daily life and materialize abstract concepts and turn them into reality. Mathematical knowledge has arisen from real-life situations. Therefore, inferences, assumptions, and applications of mathematical knowledge are intertwined with real-life situations (Eli, 2009; Gainsburg, 2008; Kösece, 2000; Winn, 1993). NCTM (2000) emphasized the connection of mathematics with daily life by stating that "students should learn mathematics by understanding it and actively constructing new knowledge from experiences and previous knowledge" (p.2). In particular, the associations established in the teachings for conceptual knowledge facilitate learning other concepts and provide valuable contributions to the development of mathematical phenomena (Skemp, 1976). At the same time, finding concepts in the mathematics lesson meaningful and having a positive attitude toward this discipline can be achieved by correlating them with daily life (Gainsburg, 2008).

Enabling individuals to use the information they acquired in real-life is among the critical outputs of mathematics teaching. Because students' ability to associate the information they learn with events in daily life is closely related to how much they can make sense of the knowledge they have acquired and how permanent the data is. Subjects and contents that are trying to teach to students in many curriculums are devoted to being associated with daily life. As long as students can associate the information, they learn with the events encountered in everyday life, the functionality of education increases and learning environments centered on individuals can be enabled. Therefore, in the process, the knowledge that students gain through education becomes permanent to the extent that it can be associated with events in daily life (Özmen, 2003). Thus, when the relationship of mathematics, both within and with other fields, is evaluated, it has been determined that it will lead to more permanent learning in children (NCTM, 2000). Therefore, the ability to associate has especially been emphasized in mathematics learning and teaching (Bingölbali & Coşkun, 2016).

Individuals must understand the nature of mathematics and be aware of its relationship with daily life to give meaning to everyday life situations. It is known that teaching by establishing a connection between life and mathematics increases students' interest and motivation contributes to their development of positive attitudes toward the lesson and facilitates their conceptual understanding (Akkuş, 2008; Arthur et al., 2017; Bingölbali & Coşkun, 2016; De Bock et al., 2003; Doruk & Umay, 2011; García-García & Dolores-Flores, 2021; Lee, 2012; Mosvold, 2008; Özgeldi & Osmanoğlu, 2017; Özgen, 2013b; Papadakis et al., 2017). However, the fact that the achievements of the students in our country are not at the desired level in international scale exams such as TIMSS (Trends in International Mathematics and Science Study) and PISA (Program for International Student Assessment), which measure the ability to integrate learned knowledge and skills into daily life, shows that the importance of mathematics in everyday life is not taken into account (MoNE, 2019; OECD, 2019). The findings of the studies in the literature also show that students have problems adapting mathematics to daily life, difficulty establishing relationships between concepts, and do not know where and how to use the information they have learned (Akar, 2020; Altay et al., 2017; Baki et al., 2009; Çavuş-Erdem et al., 2021; Doruk & Umay, 2011; Mosvold, 2008; Özgen, 2013b; Yiğit Koyunkaya et al., 2018). Considering the need to understand and use mathematics, which is increasing exponentially with each passing day, the existence of a relationship between mathematics and real-life situations becomes essential. Therefore, within the scope of the study, daily life stories

that encourage learning mathematics in its nature were included, and it was tried to determine the connections of preservice teachers between real-life situations and mathematics.

Theoretical Framework

Many institutions and organizations emphasize the importance of mathematical association, and reports and scientific research are published in this field. Especially in recent times, with the increasing interest in mathematical association ability, several changes in the definitions of mathematical association abilities draw attention. For example, mental webs structured like a spider web (Hiebert & Carpenter, 1992), schema groups associated with mental webs (Eli, 2009), large-scale ideas and processes (Coxford, 1995; Skemp, 1976), analogies (Gainsburg, 2008), knots of concepts (Ma, 1999), experiences (Marshall, 1995; Romberg & Kaput, 1999), connections with the external world (Mosvold, 2008) are some of them. Association ability is being approached within the context of the relationship between mathematical concepts and the relationship of mathematics with the natural world and other disciplines (Bingölbali & Coşkun, 2016; Van de Walle et al., 2013). In the related literature, association ability is generally grouped under four headings. These are associations between real-life situations, different disciplines, concepts, and representations (Bingölbali & Coşkun, 2016; Doruk & Umay, 2011). When we look at the relationship of mathematics with daily life, we find two dimensions. One is to be aware of the relationship between mathematics and daily life, and the other is to use these relationships to solve real-life problems (Özgen, 2013a). The content and objectives of national/international standards or curricula focus on improving students' ability to make connections throughout their education life, and efforts are made to increase the permanence of the teaching and the efficiency of the process (MoNE, 2018; NCTM, 2000; NRC, 2011). It has been shown in the primary and priority skills group because it makes valuable contributions to the development of mathematics (NCTM, 2000). There are also some axioms expected from individuals in the mathematical association process, which are meticulously focused on. According to NCTM (2000), mathematical association abilities expected from students: (i) recognizing and using relationships between mathematical ideas, (ii) understanding mathematical ideas' relation with one another, and how these relationships can build new ideas and bring them into a consistent whole, (iii) identifying and applying mathematics in disciplines other than mathematics. Based on the general framework of international organizations, the association of mathematics with daily life was emphasized by making an explanation as "developing and applying mathematical thinking to solve a series of problems encountered in daily life" under the title of mathematical competence in our country's middle school mathematics curriculum (MoNE, 2018, p. 5). The primary purpose of these steps is to facilitate understanding by establishing connections between mathematics and the real world, embodying the abstract discipline of mathematics, and contributing to its perception as accurate (Umay, 2007).

When the relevant literature was examined, it was determined in the study conducted by Altay et al. (2017) with eighth-grade students that the ability to relate mathematics to real-life situations was insufficient and that most students could only associate mathematics with numbers and shapes in real-life situations. The study by Lee (2012) examined how preservice teachers used connection skills in their own story problems. As a result of the research, it was determined that most of the problems created by preservice teachers were mainly related to calculations, time, and money contexts. The study conducted by Coşkun (2013) aimed to determine the association abilities of mathematics and classroom teachers in classroom practices and the types of connections they prefer. In the study, while teachers mainly included the association between concepts and real-life situations in their classroom practices, they gave less place to the association between different demonstrations. It has been observed that they rarely give place to association with other disciplines. It has been observed that they rarely provide association with other disciplines. Karakoç and Alacacı (2015) examined the views of 16 high school mathematics teachers and eight academicians on real-life connection examples in mathematics teaching and the advantages and disadvantages of using these examples in the classroom. At the end of the research, it was determined that mathematics teachers and academicians could provide meaningful examples of real-life connections for almost all high school

mathematics subjects. For example, using computer software and algorithms to teach logic in a real-life context is a practical example. In the study carried out by Akkuş (2008) with preservice elementary mathematics teachers, mathematical concepts and real-life connection levels of preservice teachers were examined. As a result of the research, it was determined that the preservice teachers had a sufficient level of connection skills, and the student's skills increased by the year they studied. In the study conducted by Özgeldi and Osmanoğlu (2017), it was determined that preservice teachers could make associations openly with real-life association studies, comprehend the relationships between mathematics and real- life, and could realize the benefits of associations for students. In the study conducted by Didiş-Kabar (2018), many of the preservice teachers expressed the context of "shopping" as the daily life context in which mathematics is used, and the subjects of "ratio-proportion" and "angle" as the mathematics topics that they may encounter in daily life.

Education priorities include giving meaning to real-life events and helping individuals overcome real-life difficulties. The discipline of mathematics, which intertwines with real-life situations, also contains information that makes life easier at every moment. Therefore, the bridge between mathematics and real-life situations should be built firmly. For this reason, it is essential to focus on scientific studies that focus on the ability to make connections. However, a limited number of studies deal with the ability to make connections in mathematics education in Turkey (Ece, 2021). However, considering the increasing importance of understanding mathematics and using it in real-life in the 21st-century technology era, it is evident that more studies are needed in this direction. It is hoped that the study will contribute to the importance of awareness between mathematics and daily life and create a resource for the related field.

Purpose of the Research

The study aims to determine the perceptions of elementary school mathematics preservice teachers about creating and evaluating real-life connections in story problems. Accordingly, answers to the following sub-problems were sought:

- What are the grade levels, learning area, sub-learning area, and learning outcome(s) preferred by preservice teachers while creating real-life story problems?
- What are the relationships between preservice teachers' real-life story problems and the outcome(s), the points to be considered while creating a story problem, and the real-life equivalents of story problems?
- What are the preservice teachers' views on the relationship between story problems and real-life situations, on real-life association contexts, the level of meeting the evaluation criteria, and the association of all mathematics topics with real-life situations?

METHOD

Research Model

The research was designed in the case study model since it was aimed to examine the perceptions of elementary school mathematics teacher candidates in creating and evaluating story problems. The case study method is used to explore the situations of an event, training, activity, and one or more participants in detail (Creswell, 2018). In this context, the processes of developing the research questions, developing the sub-problems of the research, determining the analysis unit, determining the situation to be studied, choosing the individuals to participate in the research, collecting the data, and associating it with the sub-problems, analyzing and interpreting the data, and reporting the case study were taken into consideration (Yıldırım & Şimşek, 2018). The research conveyed the existing situation, and categories and codes were used to analyze the data. The answers of the participants were examined thoroughly and supported by descriptive statistics.

The Study Group

The study group of the research consists of 35 students who participated in the Mathematical Connection Teaching course at the undergraduate level in the spring semester of the 2021-2022 academic year. 57% (20) of the participants were female, and 43% (15) were male. The study group

was determined according to the non-random sampling method. 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. Hence, the 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).

The Data Collection Tool

The study instruction developed by the researchers was used as a data collection tool. In creating the content of the study instruction, the opinions of the assessment, evaluation, and field experts were also taken. The relevant literature was first scanned in preparing the study guide, and the data tools and processes of studies conducted in a similar direction were carefully read (Gainsburg, 2008; Lee, 2012; Özgeldi & Osmanoğlu, 2017). In addition to the points that the participants should pay attention to, there are three headings that the participants should answer in the study guide, which was prepared with the support of the literature. The first title includes the grade level, learning area, sub-learning area, learning outcome(s), and purpose of the story problem. The second title considers some points while creating the relationship between the story problem, the outcome, and their real-life equivalent. The third title includes the relationship between the story problem and real-life situations, real-life association contexts, meeting the evaluation criteria, and the preservice teachers' views on associating all mathematics subjects with real-life situations. The names of the participants were kept confidential, and the study instruction was coded as P_1, P_2, P_3…P_{35}. Additionally, to avoid bias, the answers given by the participants were given codes and reported in the findings section.

Analysis of the Data

Descriptive analysis was used in this study. In this type of analysis, the data obtained are summarized and interpreted according to predetermined themes (Yıldırım & Şimşek, 2018). Accordingly, the answers given by each participant within the scope of the study directive were examined in the context of real-life associations. The codes determined by Gainsburg (2008) and Lee (2012) were used to develop the evaluation codes to analyze the obtained data. Furthermore, the answers of the preservice teachers were analyzed according to the learning areas, sub-learning areas, learning outcomes, terms, and concepts in the Mathematics Curriculum. In this direction, the participants' aims while creating the story problems were analyzed by Özgeldi and Osmanoğlu (2017) with the help of the codes developed according to the relevant literature (Table 1).

Table 1. Purpose codes for real-life associations (Özgeldi & Osmanoğlu, 2017, p.445)

Purposes of story problems
To attract the students' attention and motivate them
Since the context (examples given) is suitable for students
Since the context is useful
To show/raise awareness of how these concepts are used in students' lives (real lives)
To enable students to understand mathematics better, easily, and permanently by making connections with real-life situations

At the other stage, the analysis of the relationship between the story problem and the outcome(s) was discussed under six headings. These titles were determined based on the answers of the preservice teachers. Accordingly, the data, primary elements, terms, and concepts of the story problem, requiring knowledge, skills, and attitudes, being goal-oriented, and its relation with previous outcomes were considered. The codes regarding the relationship between the story problem and the outcome are presented below (Table 2).

Content analysis of the preservice teachers' answers to the issues they paid attention to while creating the story problems was made. The codes determined as a result of this analysis were used. Some sample codes are as follows: Outcome, simplicity, originality, interdisciplinary unity, suitability for student and grade level, age, language, and expression. Similarly, the content analysis of the answers to the equivalent of the story problem of the preservice teachers within real-life situations was made, and the codes determined as a result of the analysis were used. Some sample codes are as follows: The

importance of sports and healthy nutrition, energy sources, traffic rules, food waste, recycling, blood donation and games of chance, etc.

Table 2. Information on the relationship between the story problem and the outcome

The relationship between the story problem and the outcome
The story problem data is following the outcome
The main elements of the story problem are oriented toward the learning outcome
The story problem includes the terms and concepts of the outcome
The story problem requires knowledge, skills, and attitudes
The story problem is goal-oriented
The story problem also includes previous outcomes

In the last stage, content analysis was carried out on the preservice teachers' responses regarding the relationship between the story problems and real-life situations. The information obtained as a result of the analysis was evaluated according to the codes of real-life association types developed by Gainsburg (2008). Information on the code list suggested by Gainsburg (2008) is presented below (Table 3).

Table 3. Codes for real-life associations (Gainsburg, 2008, p. 200)

Real-life association types	Examples
Simple analogies	Associating negative numbers with sub-zero temperatures
Classical problems	Trains departing from the same station
Analysis of real data	Finding the average height of classmates
Discussing mathematics in society	Distortion of statistical results to guide public perception
Practical demonstrations of mathematical concepts	Models of regular objects
Mathematical modeling of real events	Writing a formula for the temperature to express an approximate function for a particular day of the year

In the other step, examples of associating the story problems created by the preservice teachers with real-life situations were examined. At this stage, the contexts determined by Gainsburg (2008) and researchers were used while determining the real-life association contexts in the participants' responses. Examples are saving, chemistry, love, encryption, waste, production, charity, sports, games, medicine, nature, and the environment. On the other hand, the story problems written by the preservice teachers were analyzed according to the evaluation criteria suggested by Lee (2012) and added by the researchers. The story problems written in the real-life situations were evaluated according to six criteria. These criteria are as follows:

- Problem instructions are clearly stated,
- Appropriate in terms of language and expression,
- Suitable for grade level,
- Have a suitable difficulty level,
- Include high-level thinking skills,
- Multiple representations are used (p. 437).

In the last stage of the research data analysis, the preservice teachers' views on associating the story problems with the mathematics subjects were examined by content analysis. The opinions of the participants were discussed under four headings. These titles are all relatable, almost all relatable, some relatable and unrelatable. On the other hand, the data were organized after the participants' answers, and the codes that supported the literature were determined. The learning areas, sub-learning areas, learning outcome(s), objectives, relationships with the outcome(s), the points they pay attention to, their counterparts, relationships, contexts (examples), and opinions were determined as frequency and percentage in real-life associations of the participants. Then, the statements of the preservice teachers for each research question in the study instructions were examined. These expressions were used to profoundly interpret the findings on how the groups made real-life associations. To increase the reliability of the study, all the answers of the participants were coded independently by the researchers. Then, the first coding was examined and determined what parts of it had disagreements.

The compliance percentage of the coding made individually by two researchers was determined as 92%. The parts where there was disagreement were discussed again, and a consensus was reached.

RESULTS

In this part of the research, the findings obtained from the answers to the real-life associations of preservice teachers are included. The findings are presented under three headings. The first title contains information about the persistent story problems [learning area, sub-learning area, learning outcome(s)] and general purposes of story problems. The second title includes the relationship between the story problem outcomes, the points to be considered while creating the story problems, and the real-life counterparts of the story problems. Finally, in the third title, teachers' views on the relationship with real-life situations, real-life association contexts, meeting evaluation criteria and associating all mathematics subjects. In this direction, information about the story problems written by the preservice teachers on their real-life situations is presented below (Table 4).

Table 4. Information on the determined story problems

Grade lLevel	Learning area	Sub-learning area	Learning outcome	Number of outcomes	*f* (%)
5	Numbers and operations	Percentages	M.5.1.6.2	1	3 (7.1)
	Geometry and measuring	Length and time measuring	M.5.2.3.3	2	2 (4.8)
	Data processing	Data collection and evaluation	M.5.3.1.1	1	1 (2.4)
6	Numbers and operations	Multipliers and products	M.6.1.2.4	1	
		Integer	M.6.1.4.2	1	3 (7.1)
		Ratio	M. 6.1.7.2	1	
	Geometry and measuring	Area calculating	M.6.3.2.4	1	2 (4.8)
			M.6.3.2.5	1	
	Data processing	Data analysis	M.6.4.1.1	1	2 (4.8)
			M.6.4.2.3	1	
7	Numbers and operations	Ratio and proportion	M.7.1.4.2	3	15 (35.6)
			M.7.1.4.4	2	
			M.7.1.4.7	4	
		Percentages	M.7.1.5.1	3	
			M.7.1.5.4	3	
	Algebra	Algebraic expressions	M.7.2.1.1	1	3 (7.1)
			M.7.2.1.2	1	
			M.7.2.1.3	1	
	Data processing	Data analysis	M.7.4.1.3	1	2 (4.8)
			M.7.4.1.1	1	
8	Numbers and operations	Exponential expressions	M.8.1.2.1	1	4 (9.5)
			M.8.1.2.4	1	
			M.8.1.2.5	2	
	Algebra	Linear equation	M.8.2.2.1	1	2 (4.8)
		Inequalities	M.8.2.3.1	1	
	Geometry and measuring	Transformation geometry	M.8.3.1.4	1	2 (4.8)
		Triangles	M.8.3.2.3	1	
	Probability	Probability of simple events	M.8.5.1.2	1	1 (2.4)

Note. In some studies, more than one outcome was preferred. The outcome explanations are presented in Appendix-1.

When Table 4 is examined, it is seen that preservice teachers create mostly story problems at the seventh-grade level (35.6%) in the field of learning numbers and operations. This is followed by the eighth-grade numbers and operations learning area (9.5%), the fifth-grade numbers and operations learning area (7.1%), the sixth-grade numbers and operations learning area (7.1%), and the seventh-grade algebra learning area (7.1%). Fifth-grade geometry and measurement learning area (4.8%), sixth-grade data processing learning area (4.8%), seventh-grade data processing learning area (4.8%), eighth-grade algebra learning area (4.8%), and geometry learning area (4.8%) have more than one story problem with content. The findings from the general objectives of the story problems written by the preservice teachers following their real-life situations are presented below (Table 5).

Table 5. General purposes of story problems (Özgeldi & Osmanoğlu, 2017)

Purposes of story problems	*f* (%)
To attract the students' attention and motivate them	8 (11.9)
Since the context (examples given) is suitable for students	8 (11.9)
Since the context is useful	6 (8.9)
To show/raise awareness of how these concepts are used in students' lives (real lives)	24 (35.9)
To enable students to understand mathematics better, easily, and permanently by making connections with real-life situations	21 (31.4)

Note. Some studies have more than one purpose.

When Table 5 is examined, it is seen that while preservice teachers create story problems suitable for real-life situations, they mainly aim to show how concepts are used in students' real lives and to raise awareness (35.9%). Similarly, among the answers of the preservice teachers, it was frequently stated that associating with real-life situations would enable the student to understand mathematics better, easily, and permanently (31.4%). Attracting students' attention/motivating them (11.9%), appropriate contexts for students (11.9%), and usefulness of context (8.9%) are other purposes. The findings from the relationship between the story problems the preservice teachers wrote following their real-life situations and the outcome(s) are presented below (Table 6).

Table 6. The relationship between the story problems and the outcome

The relationship between the story problem and the outcome	*f* (%)
The story problem data is following the outcome	6 (17.1)
The main elements of the story problem are oriented toward the learning outcome	7 (20.0)
The story problem includes the terms and concepts of the outcome	10 (28.6)
The story problem requires knowledge, skills, and attitudes	5 (14.3)
The story problem is goal-oriented	5 (14.3)
The story problem also includes previous outcomes	2 (5.7)

When Table 6 is examined, it is seen that preservice teachers pay the most attention to the fact that the outcome includes terms and concepts (28.6%) while creating a story problem suitable for real-life situations. Furthermore, the fact that the main elements of the story problem are oriented towards the outcome (20%), that their data are suitable for the outcome (17.1%), that they contain knowledge, skills, and attitudes (14.3%), that they are goal-oriented (14.3%) and that they include previous outcomes (5.7%) are the other relationships that the participants establish between the story problem and outcome(s). The findings obtained regarding the issues that preservice teachers pay attention to when writing story problems suitable for real-life situations are presented below (Table 7).

Table 7. Considerations while creating story problems

Considerations	*f* (%)	Considerations	*f* (%)
Suitability for student/grade level	27 (20.6)	Interdisciplinary collaboration	6 (4.5)
Connection with daily life	15 (11.5)	Awareness	5 (3.8)
Outcome	14 (10.7)	Age	4 (3.1)
Language and expression	12 (9.2)	Usability	4 (3.1)
Accuracy of data/information	10 (7.6)	Curriculum	3 (2.3)
Student interest, curiosity, participation, attention	10 (7.6)	Root Values	3 (2.3)
Originality	7 (5.4)	Gaining experience	3 (2.3)
Readiness level	6 (4.5)	Simplicity	2 (1.5)

When Table 7 is examined, it is seen that preservice teachers mostly pay attention to the suitability for student/grade level (20.6%) while creating story problems suitable for real-life situations. Connection with daily life (11.5%), outcome (10.7%), language and expression (9.2%), student interest, curiosity, participation, attention (7.6%), accuracy of data/information (7.6%), originality (5.4%), readiness level (4.5%) and interdisciplinary collaboration (4.5%) are among other considerations. The findings regarding the real-life responses to the preservice teachers' story problems are presented below (Table 8).

Table 8. Correspondences of story problems in real-life

Examples of real-life	*f* (%)	Examples of real-life	*f* (%)	Examples of real-life	*f* (%)
Traffic rules	4 (11.5)	Energy resources	1 (2.8)	Mother's love	1 (2.8)
Recycling	3 (8.6)	Holiday ceremonies	1 (2.8)	Stem cell transplant	1 (2.8)
Food waste	2 (5.7)	Patient analysis report	1 (2.8)	Planet	1 (2.8)
Menu/Beverage contents	2 (5.7)	Blood donation	1 (2.8)	Honey production	1 (2.8)
Agricultural/Animal production	2 (5.7)	Recruitment process	1 (2.8)	Games of fortune	1 (2.8)
Navigation	2 (5.7)	Holiday	1 (2.8)	Cryptography	1 (2.8)
The importance of sleep and rest	1 (2.8)	Advertising	1 (2.8)	Pandemic	1 (2.8)
National exam	1 (2.8)	Acids and bases	1 (2.8)	Weather	1 (2.8)
Importance of sports and healthy eating	1 (2.8)	Forest fires	1 (2.8)		

When Table 8 is examined, it is seen that preservice teachers mainly deal with traffic rules (11.5%), recycling (8.6%), food waste (5.7%), menu/beverage contents (5.7%), agricultural/animal production (5.7%) and navigation (5.7%) in the real-life equivalents of story problems. In addition, problems with subject contents such as the importance of sleep and rest, national exams, the importance of sports and healthy nutrition, energy sources, holiday ceremonies, patient analysis report, blood donation, recruitment process, and holidays were used. To explain the real-life equivalents of the problems posed by the preservice teachers in more detail, the participant's story problem, which includes the cryptography (encryption) example, is as follows:

> *Cryptography or encryption is all the methods used to convert readable information into a form unwanted people cannot understand. For example, two people who want to communicate send emails to each other. These emails go through many computers, and we don't know if anyone else has read them except the person who should be reading it…In this encryption system, the internet provider determines two prime numbers. As a result of multiplying these prime numbers, a vast number emerges… the numbers for encryption are 100-200 digits. First, create a password for yourself. Use three natural numbers for your password, and let the password of each natural number be composed of the product of two prime numbers…(P_{32}).*
>
> *According to the Highways Traffic Law, there are rules to be followed to prevent traffic accidents and ensure traffic flow and order quickly and safely. If these rules are not followed, serious problems such as traffic accidents may occur… The speed limit on highways varies from vehicle to vehicle. What do you think is the speed limit for cars in the city? (City speed limit is 50 km/h)… Speeding fines in 2022 are acceptable for exceeding the speed limit by 10-30%: 427 TL. Fine for exceeding the speed limit by 30-50%: 888 TL. Fine for exceeding the speed limit by more than 50%: 1823 TL. If paid within 15 days from the date of notification of the fine, a 25% discount will be applied… For example, the notice stated that my father was fine for driving 70 km in the city. I'll pay the fine tomorrow. How much should I pay?...(P_{28}).*

Under the example codes above, the participant's associated daily life problems with encryption and traffic rules. Participant P_{32} associated the prime factors of natural numbers with encryption and tried to determine the elements and their multiples. Participant P_{28} solves the problems related to the correct and inverse ratio and establishes a relationship between the diversity associated with the proper and inverse ratio and traffic fines based on the outcome. The findings obtained from the real-life associations of preservice teachers' story problems are presented below (Table 9).

Table 9. Real-life associations of story problems (Gainsburg, 2008, p. 200)

Types of real-life associations	*f* (%)
Simple analogies	5 (14.3)
Classic problems	10 (28.6)
Examination of actual data	6 (17.1)
Discussion of mathematics in society	11 (31.5)
Mathematical modeling of real events	2 (5.7)
Applied representations for mathematics concepts	1 (2.8)

When Table 9 is examined, preservice teachers generally discussed real-life associations in terms of discussing mathematics in society (31.5%) and classical problems (28.6%). In addition, the

examination of actual data (17.1%), simple analogies (14.3%), mathematical modeling of real events (5.7%), and realistic representations for mathematics concepts (2.8%) are other associations that preservice teachers discuss. To explain the real-life associations of the problems posed by preservice teachers in more detail, the sample story problem under the code of discussing mathematics in society is as follows:

> *According to the Ministry of Environment and Urbanization data, 1.836.000 tons of packaging waste were collected in our country in 2020. 7.000.000 kWh of energy saving was achieved in 1 year with the accumulated waste. The release of 323 million tons of greenhouse gases into nature was prevented. A contribution of 1.836.000 TL was made to the economy as recycling. Do you collect recyclable waste in your home and dispose of it in the recycling bin? If your family does not separate recyclable waste, do you give information about this? How many kWh of energy is saved with 38.556.000 packaging paper, and how many tons of greenhouse gas emissions are prevented? As a result of the recycling of 1 ton of packaging paper, how much TL contribution was made to the economy? (P_{30}).*

In the sample coding given above, the participant (P_{30}) used mathematical operations to emphasize the importance of recycling for societies. Furthermore, based on the concept of family, the smallest whole in society, the contribution of recyclable wastes that concern society to the country's economy was also discussed about greenhouse gas emissions.

Table 10. Real-life contexts of story problems (Gainsburg, 2008, p. 204)

Contexts	***f* (%)**	**Contexts**	***f* (%)**
Statistical data	6 (17.1)	Production	1 (2.8)
Transport vehicles	5 (14.3)	Chemistry	1 (2.8)
Nature/environment	3 (8.6)	Savings	1 (2.8)
Medicine	3 (8.6)	Entertainment	1 (2.8)
Waste	2 (5.7)	Love	1 (2.8)
Sports/games	2 (5.7)	Encryption	1 (2.8)
Shopping	1 (2.8)	Ceremonies	1 (2.8)
Map/plan/land measurement	1 (2.8)	Benevolence	1 (2.8)
Physics/astronomy	1 (2.8)	Exterior and interior design/architecture	1 (2.8)
Personal habits of students	1 (2.8)	Setting a price	1 (2.8)

When Table 10 is examined, real-life association contexts of preservice teachers are mostly composed of statistical data (17.1%). This is followed by transport vehicles (14.3%), nature/environment (8.6%), medicine (8.6%), waste (5.7%), and sports/games (5.7%), respectively. In addition, shopping, maps/plans/terrain, physics/astronomy, personal habits, production, chemistry, saving, entertainment, love, cryptography, ceremonies, benevolence, exterior and interior design/architecture, and price determination are among the real-life associations of preservice teachers. To explain the real-life correlation contexts of the problems posed by preservice teachers in more detail, the sample story problem under statistical data code is as follows:

> *The following information is included in the budget booklet of the Ministry of Agriculture and Forestry for the year 2022: 821 million people in the world face hunger, but more than 670 million adults and 140 million young people also face obesity problems. Food waste is mostly experienced in fresh fruits and vegetables followed by fast food and bread. 4.9 million pieces of bread are wasted every day in Turkey... 50% of the vegetables produced are wasted. A total of 18.8 million foods go to waste every year... In addition, 4.2 tons of food and 2000 liters of beverages are wasted per year in the service sector...(A_7).*

> *According to Google's advertising policy, whatever you do in a week, you will find sites, news, and advertisements about it… While the best-selling number in women's shoes was number 38 with 27%, it was followed by number 37 with 26%. While the best-selling number in men's shoes is number 42 with 25%, it is followed by number 41 with 21%. While 13 out of every 100 women buy heels, 4 out of every 50 men prefer classic shoes... (A_{14}).*

In the sample coding given above, the participant (P_7) created research questions that required data collection and associated daily life data with mathematics. Similarly, the participant (P_{14}) created a

research question based on the data of a corporate company and associated a situation frequently encountered in daily life with mathematics. The findings obtained regarding the evaluation criteria of the story problems written by the preservice teachers following the real-life situations are presented below (Table 11).

Table 11. Evaluation criteria of story problems

Number of criteria	**1**	**2**	**3**	**4**	**5**	**6**	***f* (%)**
Number of participants	4 (11.4)	5 (14.3)	7 (20.0)	7 (20.0)	11 (31.5)	1 (2.8)	35 (100)

When Table 11 is examined, 11.4% of the story problems of preservice teachers' real-life associations meet all one, 14.3% two, 20% three, 20% four, 31.5% five, and 2.8% six criteria. A detailed explanation of the story problems written by the preservice teachers following the real-life situation according to the evaluation criteria is as follows on the following example story problem:

> *A full, half, quarter?*
> *Known for his research on games of chance, Prof. Dr. Erkan Işığıçok gives striking information about the New Year's draw of the National Lottery. Since the draw was made over 10 million numbers, he said there is a 1 in 10 million chance that a purchased ticket will win the jackpot. He noted that in the last 27 years, the windfall has gone up for 2 full tickets, 5 half tickets, and 20 quarter tickets. He said there's an 85% chance that the bonus will go up to a quarter this year. There are full, half, and quarter ticket applications on the 10 million different numbers of the National Lottery tickets. When the jackpot comes to the full ticket, the entire jackpot is one person, while 2 people share half tickets and 4 people share quarter tickets… 85% of the ticket numbers are printed as a quarter, 10 half, and 5% as full tickets… Do you believe the National Lottery will be yours? Have you ever bought a ticket? Which ticket is less likely to receive a bonus, according to the report? What could this be about? Which ticket has a better chance of winning the National Lottery? In the news, the odds of getting a bonus on a ticket are higher on a quarter ticket, how is that possible? What can be done to increase the likelihood of the National Lottery? (P_{25}).*

In the sample coding given above, the participant (P_{25}) clearly stated the problem situation and the instruction and explained its content. Although its language and expression were appropriate, the class level was also considered. The participant who has taken the level of eighth grade and the subject of likelihood as a learning area and the possibility of simple events as a sub-learning area has associated the game of chance with mathematics and created the story problem at the appropriate difficulty level. At the same time, the participant included questions containing high-level thinking skills and associated the possibility of simple events with mathematics as a daily life situation by using tables. Therefore, the evaluation criteria determined for the quality of the participant story problems have all been met. Findings obtained from preservice teachers' views on associating real-life problems with all mathematics subjects are presented below (Table 12).

Table 12. Opinions on the association of story problems with mathematics subjects

Codes	***f* (%)**
All can be associated	19 (54.3)
Almost all of them can be associated	7 (20.0)
Some may be associated with	5 (14.3)
Cannot be associated	4 (11.4)

When Table 12 is examined, 54.3% of the preservice teachers think that real-life problems can be associated with all mathematics subjects, 20% of them think that almost all of them can be associated, 14.3% of them think that some of them can be associated and 11.4% of them think that they cannot be associated. Some preservice teachers' views on the association of all mathematics subjects with mathematics are as follows:

> *They can be related because all the subjects in mathematics are used in real-life and in different disciplines (physics, chemistry, biology, geography, engineering, etc.). Therefore, all mathematics subjects can be associated with concrete story problems (P_6).*

The story problem can be written with mathematics subjects, but may not be compatible with real-life. The data may not reflect real-life. For example, while calculating the volume in mathematics, some things can be neglected by numerical calculations (gaps between sand grains) (P_1).

DISCUSSION, CONCLUSION, and SUGGESTIONS

The study aimed to determine the perceptions of elementary school mathematics preservice teachers about creating and evaluating real-life connections in story problems. According to the research's first finding, most preservice teachers created real-life story problems with numbers and transactions learning area content at the seventh-grade level. Within this learning area, the ratio-proportional sub-learning area comes to the fore. One of the crucial details in the story problems written by preservice teachers is that the learning area of numbers and operations is included in all grade levels. At the grade level, the seventh graders were preferred the most. This was followed by the eighth, sixth, and fifth graders. On the other hand, story problems with the content of sub-learning areas of exponential expressions with percentages were also preferred more by preservice teachers. The results of similar studies conducted in the literature state that the samples given from daily life are generally related to numbers and transactions (Baki et al., 2009; Didiş-Kabar, 2018). Accordingly, it is thought that they reflect the situations that individuals frequently need to use in daily life on their story problems. Therefore, the contexts related to numbers and operations are dominant in preservice teachers' perceptions about the use of mathematics in daily life. In addition, the fact that subjects such as ratio-proportion, percentages, and exponential expressions are preferred more indicates that the perceptions of mathematics preservice teachers are limited to certain subjects. Although the participants were free to choose whatever they wanted while determining the story problems, they tended to create more story problems on specific topics. The reason for this may be the effect of preservice teachers' mathematics knowledge on problems. However, the fact that teachers limited the relationship of mathematics with real-life situations to topics such as numbers and calculations may have affected the participants' preferences (Baki et al., 2009). Because teachers often get help from numbers and operations in embodying and making mathematics understandable. It is expected that preservice teachers trained with this understanding will turn to similar examples.

Another study finding was obtained from the objectives determined by the preservice teachers while creating story problems suitable for real-life situations. Accordingly, preservice teachers aimed to show how the concepts they determined while writing story problems suitable for real-life situations are used in students' lives and to raise awareness about this issue. This finding is consistent with the statements in the literature that daily life problems should be emphasized to support meaningful learning as well as overlapping with similar study results (Akkuş, 2008; Baki et al., 2009; Karakoç & Alacacı, 2015; Lee, 2012; Özgeldi & Osmanoğlu, 2017). In addition, enabling the student to understand mathematics better, more accessible, and permanently by associating it with real-life is another goal adopted by preservice teachers. Like the preservice teachers who participated in the studies conducted by Lee (2012) and Yiğit Koyunkaya et al. (2018), the preservice teachers in this study presented different perspectives on the effects of associating with daily life. Preservice teachers stated that by associating with daily life, we could make the student aware of the place of mathematics in our lives and arouse curiosity outcomes of mathematics. In this regard, outcomes Gainsburg (2008) stated that teachers generally chose to motivate students, attract them, and show that mathematics is more understandable when choosing real-life contexts.

Another research finding was obtained from the relationship between story problems and outcomes. Preservice teachers focused on the terms and concepts of the most outcomes in story problems and the least on the connection of the outcome(s) with the previous outcome(s). Other focused points are that the problem data are suitable for the outcome, the main elements of the problem are aimed at the outcome, the problem contains knowledge, skills, and attitudes, and the problem is goal-oriented. Accordingly, teachers observed the outcomes more by using daily life connections. In this respect, it is crucial to focus on practices in the content of undergraduate courses to enrich and diversify the perceptions of preservice teachers in daily life connections (Bukova Güzel et al., 2018; Gainsburg,

2008; Didiş & Kabar, 2018; Karakoç & Alacacı, 2015). Furthermore, Didiş-Kabar (2018) emphasizes the reflections on course achievements in daily life by stating that the learned mathematics knowledge contributes to the problems encountered in daily life in terms of practical solutions and calculation. In this respect, bringing preservice teachers together with a learning environment that allows the development of their multiple mathematical approaches can make valuable contributions to adopting an inquiry-based teaching approach in their future careers (Gainsburg, 2008; Karakoç & Alacacı, 2015).

Another research finding determined what the preservice teachers paid attention to while creating story problems. While creating real-life problems, preservice teachers paid the most attention to the suitability of students and grade level. Overlapping with real-life situations, attainment, language and expression, data accuracy, student interest, curiosity, and authenticity are among the other issues that preservice teachers pay attention to the problem. In this context, preservice teachers are aware of the importance of their daily life status for students and attach importance to the transfer of the learned information to daily life. Therefore, it is essential to elaborate on the teaching knowledge that includes the relationship of mathematics with daily life in teacher training programs and to develop the mental habits of preservice teachers in this regard. Many curricula and scientific studies emphasize the connection of mathematics with daily life and state that daily life problems should be included more in learning environments (Lee, 2012; NCTM, 2014; Özgen, 2013b).

One of the remarkable findings of the research is the real-life correspondence of the story problems created by preservice teachers. Accordingly, traffic rules and recycling content story problems were the most preferred subjects. Food waste, menu/beverage contents, agricultural/animal production, and navigation are other topics in the preservice teachers' story problems. While creating real-life story problems, teachers' preferences for various disciplines such as stem cell transplantation, weather, acids and bases, sports, and the importance of healthy nutrition draw attention. One of the most important reasons for the participants to give examples from different numbers and types of daily life is that mathematics has many reflections on our lives (Bukova Güzel et al., 2018). The situations frequently encountered in daily life are reflected more in the problems. Accordingly, it can be said that the participants are trying to associate mathematical concepts with daily life. Studies indicate that preservice teachers have various knowledge in associating mathematics subjects/concepts with real-life (Arthur et al., 2018; Coşkun, 2013; Gainsburg, 2008; Lee, 2012; Mutlu & Akgün, 2016; Özgen, 2013a; Yiğit Koyunkaya, 2018). Although preservice teachers know this subject, it is evident that studies should focus on increasing their competence.

When the real-life associations of preservice teachers in story problems are examined in the research, the types of associating classical problems with the discussion of mathematics in society draw attention the most. Simple analogies with the examination of accurate data are other topics in preservice teachers' real-life associations with story problems. On the other hand, preservice teachers preferred associating mathematical modeling of actual events with realistic representations of mathematical concepts. This finding also coincides with the results of similar studies in the literature (Gainsburg, 2008; Lee, 2012; Özgeldi & Osmanoğlu, 2017). This finding is thought to be because preservice teachers attribute meaning to them by being influenced by life events. Especially the quality of social events affected the examples given more and preservice teachers gave examples in this direction. In this context, preservice teachers are aware of the effect of real-life contexts on mathematics and act to establish a relationship between mathematics and real-life situations (Gainsburg, 2008; Lee, 2012). On the other hand, preservice teachers preferred it more in stories with classical problem content. This situation is shown to be the excessive use of such problems in textbooks and additional resources (Gainsburg, 2008). In addition, the learning environments in the education life, the content of the course materials, and the outputs of the curriculum may have caused preservice teachers to turn to more classical problems. Therefore, we should train preservice teachers to create learning experiences that allow questioning and developing high-level thinking skills and monitor their effectiveness.

When the findings related to the real-life association contexts of story problems were examined in the research, statistical data, transportation tools, nature/environment, and medical samples were preferred more by preservice teachers. Apart from these, waste, sports, shopping, map/plan/land measurement, physics/astronomy, personal habits, production, chemistry, saving, entertainment, love, encryption, ceremony, benevolence, exterior and interior design/architecture, and price determination are other contexts preferred by preservice teachers. Context preferences are essential in the permanence of the information students acquire. For this reason, contexts that encourage students to think about using the learned knowledge in daily life should be used more. This way, the transfer of new knowledge and skills acquired by the learners to different situations is facilitated (Winn, 1993). In a similar study by Özgeldi and Osmanoğlu (2017), preservice teachers gave examples for sports/games, shopping/price determination/eating contexts. The study by Lee (2012) determined that money/time-content contexts came to the forefront. Although these differences are expected, the interest and ability of preservice teachers may have affected the types of contexts they exemplify. Individuals perceive mathematics as isolated facts and procedures (NCTM, 2014). Therefore, learning experiences that preservice teachers can experience and realize how the real-life connections of mathematical concepts are established should be created. For this, improving course materials and teacher quality is recommended (Arthur et al., 2017).

One of the noteworthy findings of the research is that only one of the story problems that the preservice teachers wrote in real-life situations meets the evaluation criteria of "problem instructions are clearly stated, appropriate in terms of language and expression, appropriate for the class level, appropriate difficulty level, high-level thinking skills, and multiple representations were used." Nearly one-third of the story problems meet five criteria, while one-fifth meet four, and an outcome one-fifth meets three criteria. In preservice teachers' story problems, the problem instructions were not explicitly stated, and the lack of questions about high-level thinking skills decreased the rate of evaluation criteria. Approximately one-quarter of the story problems created has at least one or two evaluation criteria. In this context, preservice teachers should carefully create evaluations that value establishing and learning daily life connections (Eli, 2009). Increasing the number of courses, such as associating with mathematics teaching, is essential. This will help the new generation of teachers use mathematical association with a more professional approach to teaching practices (Akar, 2020). It is known that preservice teachers have problems reflecting their associative skills and thoughts about daily life to verbal problems (Çavuş Erdem et al., 2021; Gainsburg, 2008; Lee, 2012; Özgen, 2013a; Yiğit Koyunkaya, 2018). Therefore, preservice teachers should be taught how to transform their thoughts about daily life following the problems. However, it should not be forgotten that it is essential not to use situations with many real-life relationships in the lesson but to ensure that students are active in the processes (Mosvold, 2008).

The last finding of the study was obtained from the views on associating the story problems written in real-life situations with mathematics subjects. Accordingly, three-quarters of the preservice teachers stated that story problems could be associated with mathematics subjects. On the other hand, a quarter of the preservice teachers stated that some subjects could or could not be associated. This finding is in line with the study conducted by Özgeldi and Osmanoğlu (2017) on the use of preservice teachers' real-life stories. In the study of Didiş-Kabar (2018), most preservice teachers stated that using daily life problems (situations) in mathematics lessons would benefit the students. In the study by Yiğit Koyunkaya et al. (2018), most preservice teachers argued that associating it with daily life effectively teaches mathematics and its necessity. Similarly, in the study by Karakoç and Alacacı (2015), teachers and academicians stated that real-world connections could improve students' motivation, interests, and attitudes, as well as their problem-solving skills and conceptual learning. Accordingly, it can be said that preservice teachers are aware of the connections of mathematics with real-life situations and understand its importance. However, the limited amount of information in the relevant literature and sourcebooks increases the incompetence of preservice teachers in this regard. In this context, increasing awareness of the design and use of course contents in curricula based on associations is

crucial. Especially in this regard, it may be beneficial to increase practice-oriented undergraduate courses, conduct training, and develop association-oriented resources.

Limitations

One of the most important limitations of the study is that only the study instructions were used as the data collection tool. Another limitation is that the study was conducted with 35 volunteer preservice teachers who took the Mathematical Connection Teaching course. The real-life contexts discussed in this study consist of preservice teachers' perspectives. When prospective teachers are assigned as teachers, there may be changes in their thoughts and views. The fact that preservice mathematics teachers were given a certain amount of time to determine their perceptions of creating and evaluating real-life connections in story problems may also affect their thoughts.

Suggestions

The course contents can be rearranged during the preservice teacher training process so that preservice teachers can realize the importance of real-life associations earlier and have a more in-depth idea about these associations. Learning activities, workshops, and seminars can be organized to make preservice mathematics teachers and preservice teachers in other branches aware of the importance of associating with real-life. The teachers can evaluate the types of associations revealed by the preservice teachers in the studies, and their opinions on their use in the lessons can be obtained. In addition, longitudinal studies can be done to understand the effects of real-life associations better. Finally, elective courses at the undergraduate level can be included for effectively using real-life contexts. A similar study can also be done in the form of group work.

Ethics and Conflict of Interest

The ethical permission of this study was obtained from the Research Ethics Committee of Nevşehir Hacı Bektaş Veli University (date 27.04.2022, number 128/05); it was decided that the research is following the human research ethics committee directive. The authors declare that they have no potential conflict of interest.

REFERENCES

Akar, Z. Y. (2020). Seventh-grade students' mathematical connection skills in ratio and proportion. *International Journal of Educational Studies in Mathematics, 27*(4), 271-288.

Akkuş, O. (2008). Preservice elementary mathematics teachers' level of relating mathematical concepts in daily life contexts. *Hacettepe University Journal of Education, 35,* 1-12.

Altay, M. K., Yalvaç, B., & Yeltekin, E. (2017). 8th-grade student's skill of connecting mathematics to real-life. *Journal of Education and Training Studies, 5*(10), 158-166. https://doi.org/10.11114/jets.v5i10.2614

Arthur, Y. D., Owusu, E. K., Asiedu-Addo, S., & Arhin, A. K. (2018). Connecting mathematics to real-life problems: A teaching quality that improves students' mathematics interest. *IOSR Journal of Research & Method in Education, 8*(4), 65-71. http://dx.doi.org/10.9790/7388-0804026571

Arthur, Y. D., Asiedu-Addo, S., & Assuah, C. (2017). Connecting mathematics to real-life problem using instructor quality and availability, mathematics facility and teacher motivation for prediction. *International Journal of Scientific Research in Education, 10*(3), 311-324.

Baki, A., Çatlıoğlu, H., Coştu, S., & Birgin, O. (2009). Conceptions of high school students about mathematical connections to the real-life. *Procedia Social and Behavioral Sciences, 1*(1), 1402-1407. http://dx.doi.org/10.1016/j.sbspro.2009.01.247

Bingölbali, E., & Coşkun, M. (2016). A proposed conceptual framework for enhancing the use of making connections skill in mathematics teaching. *Education and Science, 183,* 233-249. http://dx.doi.org/10.15390/EB.2016.4764

Bukova Güzel, E., Tekin Dede, A., Hıdıroğlu, Ç. N., Kula Ünver, S., & Özaltun Çelik, A. (2018). Matematiksel modellemeye giriş [Introduction to mathematical modeling]. In E. Bukova Güzel (Ed.), *Matematik eğitiminde matematiksel modelleme* [Mathematical modeling in mathematics education] (pp. 1-16). Anı Publishing.

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2016). *Bilimsel araştırma yöntemleri* [Scientific research methods] (25th ed.). Pegem Academy Publishing.

Chapman, O. (2012). Challenges in mathematics teacher education. *Journal of Mathematics Teachers Education, 15*(4), 263-270. https://doi.org/10.1007/s10857-012-9223-2

Cresswell, J. W. (2018). *Nitel araştırma yöntemleri. Beş yaklaşıma göre nitel araştırma ve araştırma deseni* [Qualitative research methods. Qualitative research and research design according to five approaches]. (M. Bütün & S. B. Demir, Trans.) (4th ed.). Siyasal Bookstore.

Coşkun, M. (2013). *Matematik derslerinde ilişkilendirmeye ne ölçüde yer verilmektedir? Sınıf için uygulamalardan örnekler* [To what extent making connections are given place in mathematics classes? Examples from real classroom practices] (Unpublished master's thesis). Gaziantep University.

Coxford, A. F. (1995). The case for connections. In P. A. House, & A. F. Coxford (Eds.), *Connecting mathematics across the curriculum,* (pp. 3-12). National Council of Teachers of Mathematics.

Çavuş Erdem, Z., Doğan, M. F., & Gürbüz, R. (2021). Ortaokul öğrencilerinin disiplinler arası matematiksel modelleme becerilerinin incelenmesi [Investigation of middle school students' interdisciplinary mathematical modeling skills]. *Cumhuriyet International Journal of Education, 10*(4), 1763-1788. http://dx.doi.org/10.30703/cije.927243

De Bock, D., Verschaffel, L., Janssens, D., Van Dooren, W., & Claes, K. (2003). Do realistic contexts and graphical representations always have a beneficial impact on students' performance? Negative evidence from a study on modelling non-linear geometry problems. *Learning & Instruction, 13*(4), 441-463.

Didiş Kabar, M. G. (2018). Investigating mathematics teacher candidates' perceptions and views about connections between mathematics and the real world. *Inonu University Journal of the Faculty of Education, 19*(3), 266-283. https://doi.org/10.17679. inuefd.341702

Doruk, B. K., & Umay, A. (2011). Matematiği günlük yaşama transfer etmede matematiksel modellemenin etkisi [The effect of mathematical modeling on transferring mathematics into daily life]. *Hacettepe University Journal of Education, 41*, 124-135.

Ece, T. (2021). *Matematik eğitiminde ilişkilendirme becerisi: Sistematik derleme çalışması* [Connections skills in mathematics education: A systematic review study] (Unpublished master's thesis). Necmettin Erbakan University.

Eli, J. A. (2009). *An exploratory mixed methods study of prospective middle grades teachers' mathematical connections while completing investigative tasks in geometry* (Unpublished doctoral dissertation). University of Kentucky.

English, L. D., & Watters, J. J. (2004). Mathematical modeling in the early school years. *Mathematics Education Research Journal, 16*(3), 59-80. https://doi.org/10.1007/BF03217401

Eurydice (2012). *The European higher education area in 2012: Bologna process implementation report.* Brussels: EACEA P9 Eurydice. 9 May 2022 retrieved from http://eacea.ec.europa.eu/education/eurydice

Freudenthal, H. (1991). *Revisiting mathematics education: China lectures.* Kluwer Academic Publishing.

García-García, J., & Dolores-Flores, D. (2021). Exploring pre-university students' mathematical connections when solving Calculus application problems. *International Journal of Mathematical Education in Science and Technology, 52*(6), 912-936. https://doi.org/10.1080/0020739X.2020.1729429

Gainsburg, J. (2008). Real-world connections in secondary mathematics teaching. *Journal of Mathematics Teacher Education, 11*(3), 199-219. https://doi.org/10.1007/s10857-007-9070-8

Hiebert, J., & Carpenter, T. P. (1992). Learning and teaching with understanding. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 65-97). Mcmillan Publishing.

Karakoç, G., & Alacacı, C. (2015). Real world connections in high school mathematics curriculum and teaching. *Turkish Journal of Computer and Mathematics Education, 6*(1), 31-46. https://doi.org/10.16949/turcomat.76099

Kösece, P. (2020). *Gerçekçi matematik eğitimi yoluyla matematiği gerçek yaşamla ilişkilendirme ve tahmin becerisini geliştirmeye yönelik bir eylem araştırması* [An action research upon associating mathematics with real-life through realistic mathematics education and developing the skill of prediction] (Unpublished doctoral dissertation). Çukurova University.

Lee, J. E. (2012). Prospective elementary teachers' perceptions of real-life connections reflected in posing and evaluating story problems. *Journal of Mathematics Teacher Education, 15*(6), 429-452. https://doi.org/10.1007/s10857-012-9220-5

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teacher's understanding of fundamental mathematics in China and the United States.* Lawrence Erlbaum Associates.

Marshall, S. P. (Ed.). (1995). *Schemas in problem solving.* Cambridge University Press.

Ministry of National Education (MoNE) (2019). *PISA 2018 Türkiye ön raporu* [PISA 2018 Turkey preliminary report]. Ankara. 9 June 2022 retrieved from http://pisa.meb.gov.tr/www/raporlar/icerik/5

Ministry of National Education (MoNE) (2018). *Matematik dersi öğretim programı (ilkokul ve ortaokul 3, 4, 5, 6, 7 ve 8. sınıflar)* [Mathematics curriculum (primary and middle school 3rd, 4th, 5th, 6th, 7th and 8th grades)]. Board of Education and Discipline.

Mosvold, R. (2008). *Real-life connections in Japan and the Netherlands: National teaching patterns and cultural beliefs. International Journal for Mathematics Teaching and Learning.* Plymouth University, UK: Centre for Innovation in Mathematics Teaching 9 June 2022 retrieved from http://www.cimt.org.uk/journal/mosvold.pdf

Mutlu, Y., & Akgün, L. (2016). 1998-2013 SBS-OKS sınav sorularının matematik okuryazarlığı ekseninde içerik ve bağlam yönünden değerlendirilmesi [Assessment of 1999-2013 SBS-OKS exam questions in the axis of mathematics literacy in terms of content and context]. *Turkish Studies, 11*(3), 1769-1780. http://dx.doi.org/10.7827/TurkishStudies

National Council of Teachers of Mathematics (NCTM) (2014). *Principles to actions: Ensuring mathematical success for all.* NCTM.

National Council of Teachers of Mathematics (NCTM) (2000). *Principles and standards for school mathematics.* NCTM.

National Research Council (NRC) (2011). *Assessing 21st century skills: Summary of a workshop: National Academies Press.* 3 June 2022 retrieved from https://pubmed.ncbi.nlm.nih.gov/22379654/

Organization for Economic Co-operation and Development (OECD) (2019). *PISA 2018 results (Volume II), where all students can succeed.* OECD Publishing. https://doi.org/10.1787/b5fd1b8f-en

Özgeldi, M., & Osmanoğlu, A. (2017). Connecting mathematics to real-life: An investigation on how prospective secondary mathematics teachers build real-life connections. *Turkish Journal of Computer and Mathematics Education, 8*(3), 438-458. https://doi.org/10.16949/turkbilmat.298081

Özgen, K. (2013a). Mathematical connection skill in the context of problem solving: The case of pre-service teachers. *E-Journal of New World Sciences Academy, 8*(3), 323-345. http://dx.doi.org/10.12739/NWSA.2013.8.3.1C0590

Özgen, K. (2013b). Self-efficacy beliefs in mathematical literacy and connections between mathematics and real world: The case of high school students. *Journal of International Education Research, 9*(4), 305-316.

Özmen, H. (2003). Chemistry student teachers' levels of linking their knowledge with daily life about acid and base concepts. *Kastamonu Education Journal, 11*(2), 317-324.

Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2017). Improving mathematics teaching in kindergarten with realistic mathematical education. *Early Childhood Education Journal, 45*, 369-378. https://doi.org/10.1007/s10643-015-0768-4

Romberg, T. A., & Kaput, J. J. (1999). Mathematics worth teaching, mathematics worth understanding. In E. Fennema & T. A. Romberg (Eds.), *Mathematics classrooms that promote understanding* (pp. 3-17). Lawrence Erlbaum.

Skemp, R. R. (1976). Relational understanding and instrumental understanding. *Mathematics Teaching, 77*(1), 20-26.

Umay, A. (2007). *The new face of our old friend school mathematics.* Aydan Web Foundations.

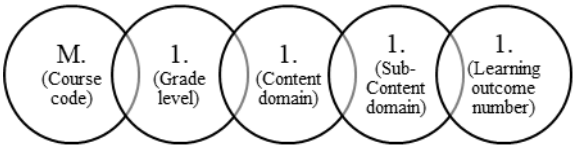
Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2013). *İlkokul ve ortaokul matematiği: Gelişimsel yaklaşımla öğretim* [Elementary and middle school mathematics: Teaching developmentally], (S. Durmuş, Trans. Ed.). Nobel Academic Publishing.

Winn, W. (1993). Instructional design and situated learning: Paradox or Partnership? *Educational Technology, 33*(3), 16-21.

Yıldırım, A., & Şimşek, H. (2018). *Sosyal bilimlerde nitel araştırma yöntemleri* [Qualitative research methods in the social sciences] (11th ed.). Seçkin Publishing.

Yiğit Koyunkaya, M., Uğurel, I., & Tataroğlu Taşdan, B. (2018). Reflection of preservice teachers' thoughts about connecting mathematics and real-life situations on their mathematics learning activities. *Journal of Uludağ University Faculty of Education, 31*(1), 117-2016. https://doi.org/10.19171/uefad.450083

Appendix-1: Preferred Learning Outcomes by Preservice Teachers



M.5.1.6.2: Associates a percentage expression with a fraction and decimal notation representing the same magnitude, converting these notations to each other.
M.5.2.3.3: Recognizes time measurement units, convert them to each other, and solves related problems.
M.5.3.1.1: Creates research questions that require data collection.
M.6.1.2.4: Determines the prime factors of natural numbers.
M.6.1.4.2: Compares and ranks integers.
M. 6.1.7.2: In cases where a whole is divided into two parts, it determines the ratio of two parts to each other or each part to the whole, and in case of problems, it finds the other when one of the ratios is given.
M.6.3.2.4. Recognizes land measurement units and associates them with standard area measurement units.
M.6.3.2.5. Solves the problems related to the field.
M.6.4.1.1: Creates research questions that require comparing two data groups and obtaining appropriate data.
M.6.4.2.3: It uses the arithmetic mean and span to compare and interpret the two groups' data.
M.7.1.4.2: When one of the two multiplicities is given a ratio, it finds the other.
M.7.1.4.4: It refers to the relationship between two directly proportional multiplicities.
M.7.1.4.7: Solves problems related to correcting an inverse ratio.
M.7.1.5.1: Finds the amount corresponding to a specified percentage of a plurality, and a certain percentage finds the whole of the given multiplicity.
M.7.1.5.4: Solves problems related to percentage.
M.7.2.1.1: Performs addition and subtraction operations with algebraic expressions.
M.7.2.1.2: Multiplies an algebraic expression by a natural number.
M.7.2.1.3: Expresses the rule of number patterns in letters and finds the desired term of the pattern whose rule is expressed in letters.
M.7.4.1.3: Creates and interprets the circle graph for a data group.
M.7.4.1.1: Creates and interprets the line graph of the data.
M.8.1.2.1: Calculates the integer strengths of integers.
M.8.1.2.4: It refers to a given number using different integer forces of 10.
M.8.1.2.5: Expresses and compares large and minimal numbers with scientific representation.
M.8.2.2.1: Solves equations with a first-order unknown.
M.8.2.3.1: Write mathematical sentences suitable for everyday life situations involving inequality with a first-degree unknown.
M.8.3.1.4: Draw a triangle whose dimensions are given by a sufficient number of elements.
M.8.3.2.3: It creates the image of polygons due to translation and reflections.
M.8.5.1.2: Distinguishes and gives examples of events with more, "equal" or "less" probability.