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Factors Affecting Mathematics Teachers' Process of Constructing Problems with Real-Life Contexts*

Matematik Öğretmenlerinin Gerçek Yaşam Bağlamları İçeren Problemleri Kurma Süreçlerine Etki Eden Faktörler

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ABSTRACT

In this study, the factors affecting mathematics teachers' problem posing processes involving real-life contexts were examined in depth. The study aims to reveal the difficulties teachers face in the problem posing process, the strategies they use, and the cognitive, pedagogical and contextual factors that are effective in this process. Qualitative research method was adopted in the study and semi-structured interviews were conducted with teachers during the data collection process. The data obtained were analyzed and the main factors shaping teachers' problem posing processes were identified. The findings of the study reveal the effects of teachers' tendency to associate real-life contexts with course content, their experiences and professional knowledge on the problem posing process. In addition, the role of teachers in guiding and structuring the problem posing process by taking into account the needs of students and guiding students through the outcomes and explanations in the mathematics curriculum also comes to the fore. The obtained results emphasize the importance of professional development programs that include practical trainings, workshops, and interactive learning environments based on experience sharing among teachers in order to improve mathematics teachers' problem posing skills related to real-life; in this direction, it offers various suggestions for teacher education.

Yazar Bilgileri

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ÖZ

Bu araştırmada, matematik öğretmenlerinin gerçek yaşam bağlamlarını içeren problemleri kurma süreçlerini etkileyen faktörler derinlemesine incelenmiştir. Araştırma, öğretmenlerin problem kurma sürecinde karşılaştıkları zorlukları, kullandıkları stratejileri ve bu süreçte etkili olan bilişsel, pedagojik ve bağlamsal unsurları ortaya koymayı amaçlamaktadır. Çalışmada nitel araştırma yöntemi benimsenmiş olup veri toplama sürecinde öğretmenlerle yarı yapılandırılmış görüşmeler yapılmıştır. Elde edilen veriler analiz edilmiş ve öğretmenlerin problem kurma süreçlerini şekillendiren temel faktörler belirlenmiştir. Araştırma bulguları, öğretmenlerin gerçek yaşam bağlamlarını ders içeriğiyle ilişkilendirme eğilimlerinin, sahip oldukları deneyimlerin ve mesleki bilgilerinin problem kurma sürecine olan etkilerini ortaya koymaktadır. Ayrıca öğretmenlerin öğrencilerin ihtiyaçlarını göz önünde bulundurma durumları ile matematik öğretim programının içerdiği kazanımlar ve açıklamalar yoluyla öğrencilere rehberlik ederek problem kurma sürecini yönlendirme ve yapılandırma konusundaki rolü de ön plana çıkmaktadır. Elde edilen sonuçlar, matematik öğretmenlerinin gerçek yaşamla ilişkili problem kurma becerilerini geliştirmek amacıyla uygulamaya dönük eğitimler, atölye çalışmaları ve öğretmenler arasında deneyim paylaşımına dayalı etkileşimli öğrenme ortamlarını içeren mesleki gelişim programlarının önemini vurgulamakta; bu doğrultuda öğretmen eğitimine yönelik çeşitli öneriler sunmaktadır.

Makale Bilgileri

Keywords
Problem posing
Real-life contexts
Teacher opinions

Anahtar Kelimeler
Problem kurma
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Introduction

Problem Posing

Mathematics is one of the most fundamental components of human thinking and stands out as a field open to development through problem solving and problem posing skills. Mathematical thinking is generally based on generating new solutions using existing knowledge, understanding abstract and logical relationships, and developing mathematical models appropriate to real-life problems (Polya, 1945). Mathematical knowledge does not only consist of memorizing certain formulas and rules, but also includes using this knowledge to formulate problems appropriate to new situations. In this context, problem posing in mathematics is a fundamental process that enables the application of existing knowledge to new situations and the development of analytical and critical thinking skills (Silver, 1994). Problem posing helps students to better understand mathematical concepts and to use their knowledge in new contexts (Cai, 2003).

Realistic mathematics education ensures that students learn mathematical knowledge not only at an abstract level but also in a way that they can use it in their daily lives and in real-life. This approach allows mathematics to become a meaningful and contextual experience for students, not just memorizing formulas (Lesh & Doerr, 2003). Realistic mathematics education not only develops students' problem solving skills but also encourages them to use mathematics effectively in their lives. Realistic mathematics education enables students to relate mathematical concepts to daily life by supporting them with contextual problems. Such problems require students to apply the mathematical knowledge and skills they have learned to real-life situations. Students realize that mathematics is not only a subject within the confines of a textbook, but also a tool that is intertwined with daily life (English, 1997). Mathematical thinking makes abstract concepts concrete and transforms them into a form that can be applied in real-life.

Contextual problems are problems based on real-life scenarios and require the application of mathematical knowledge and skills (Gravemeijer & Doorman, 1999). Such problems help students to relate abstract mathematical concepts to real-life. Mathematical problems enriched with real-life contexts play a critical role in developing students' mathematical thinking skills and making mathematics meaningful (Blum & Ferri, 2009). Data and contexts taken from real-life enable students to see mathematics not only as an abstract field but also as a tool that is intertwined with daily life (English, 1997). In this context, contextual problems should be designed in such a way that they are not only solution-oriented but also help students understand real-life situations. Therefore, the process of bringing such problems into the classroom is a multifaceted process that requires teachers' mathematical knowledge and skills as well as their pedagogical competencies. Teachers make different decisions while preparing such problems by using mathematical concepts, methods and solution techniques, as well as pedagogical approaches to students' understanding. Today, academic studies on the factors affecting this process are still under development.

Mathematics teachers' problem posing process involves many elements such as individual factors (content knowledge, pedagogical competence, experience), external factors (curriculum, classroom environment, resources) and socio-cultural factors (social expectations, student profile) (Chapman, 2013). The challenges that teachers face in the process of relating real-life contexts to mathematics problems and the strategies they develop against these challenges constitute an important research area in the context of teacher education and professional development (Liljedahl, Santos-Trigo, Malaspina & Bruder, 2016). Teachers' mathematical modeling competencies and the development

process of these competencies, especially when constructing problems involving real-life contexts, is an important research topic (Kaiser & Sriraman, 2006). The mathematical modeling process enables teachers not only to teach a specific mathematical concept, but also to play an important role in encouraging students' active participation in the problem solving process and in developing strategies in this process, i.e. in the planning stages (Borromeo Ferri, 2018).

Importance of the Research and Contribution to the Literature

Blum and Leiss (2007) state that problems designed using real-life contexts increase students' motivation, but create additional challenges for teachers. These challenges include finding appropriate data and scenarios from real-life, mathematical modeling at a level that students can understand, and effective implementation in the classroom (Stillman, Brown & Galbraith, 2013). It is also emphasized that teachers should receive more practice-based training in order to improve their problem posing skills (Singer, Ellerton & Cai, 2013; Zawojewski, 2010). Teachers should be supported on how to create meaningful and contextual problems that can attract students' interest, different from traditional problem posing processes.

Mathematical problem posing is important not only for students but also for teachers' own pedagogical development. The problem posing process allows teachers to improve their lesson planning skills, develop a deeper understanding of the relationships among mathematical concepts, and design activities that are appropriate for their students' cognitive levels (Cai & Hwang, 2002). Therefore, understanding the factors affecting mathematics teachers' problem posing process is critical not only for problem solving but also for teacher education and professional development. Research on the problem posing process in mathematics education shows that teachers' development of this skill has a direct impact on students' problem-solving competencies (Silver, 2013). Therefore, more research is needed on how teachers can be supported in problem posing processes, which pedagogical approaches are effective, and how the difficulties encountered in this process can be overcome.

This study aims to fill the gap in the literature by examining the factors affecting mathematics teachers' problem posing processes involving real-life contexts. To this end, a detailed analysis was conducted on the difficulties teachers face in this process, the approaches they prefer during problem posing, and the areas they need to improve. The findings of the study are expected to contribute to both teacher training programs and the professional development of current teachers. In addition, by providing suggestions on how teachers can make their problem posing processes more effective, it will enable the development of approaches that will encourage the use of real-life contexts in mathematics teaching.

Method

Research Model

In this study, a qualitative research approach was adopted to examine in depth the factors affecting mathematics teachers' problem posing processes involving real-life contexts. Qualitative research offers an approach to explore individuals' experiences, perceptions and how they make sense of these experiences. At the same time, it provides a holistic understanding of social phenomena together with the contexts in which individuals live, allowing for an in-depth understanding of the researched topic (Creswell, 2013; Merriam, 2015). The constructivist approach was used to understand mathematics teachers' problem posing processes and to reveal the teaching approaches, pedagogical, cognitive and environmental factors affecting these processes. This approach is a qualitative approach

that focuses on exploring how individuals make sense of and construct social phenomena as well as their personal experiences, intellectual processes, and interactions with their environment (Charmaz, 2014). Unlike the traditional approach (Glaser & Strauss, 1967), it emphasizes the interpretive role of the researcher and allows the research process to proceed in a flexible and exploratory structure. In this context, the basic principles are the interaction of the researcher with the participants, contextual interpretation of the data and continuous review of the categories developed throughout the process.

Participants

The study was conducted in the 2022-2023 academic year with the participation of 26 mathematics teachers after obtaining the necessary permissions. In determining the study group, convenience sampling and criterion sampling methods were used together. While convenience sampling allows the researcher to reach the participants efficiently in terms of time and effort, the criterion sampling method aims to include individuals who meet the specified criteria (Creswell, 2013). In this direction, three basic criteria were determined in the selection of teachers to be included in the study:

- Teaching experience: Teachers with at least five years of professional experience were preferred.
- Different levels of education: By working with elementary and secondary level mathematics teachers, a broader perspective on problem posing processes was obtained.
- Problem posing experience involving real-life contexts: Teachers who included problems with real-life contexts in their teaching processes were specifically selected.

In line with these criteria, it was aimed to obtain qualified data suitable for the purpose of the study by ensuring that the teachers included in the study had experience in the processes of creating real-life problems in the context of mathematics teaching.

Considering the purpose and method of the study, care was taken to select the teachers participating in the interviews on the basis of willingness and voluntariness. It is important for the reliability of the research that the teachers in the study group have sufficient knowledge in mathematics and are willing to improve themselves. Teachers were informed that their personal information would not be disclosed and that all ethical rules would be strictly followed in the research process. In line with ethical principles, the real names of the teachers were not used and each teacher was given unique codes by the researcher. In this coding, no order was used and the teachers were coded as Secondary School Mathematics Teachers (SSMT) and High School Mathematics Teachers (HSMT).

Ethical Statement

This study was conducted in accordance with the approval of Gazi University Rectorate Ethics Committee on 21.03.2023, with reference number 05.

Data Collection Tool and Process

In this study, semi-structured interviews were conducted in order to understand the experiences of mathematics teachers regarding problem posing processes, the difficulties they face and the factors affecting this process. The interview questions were designed to explore how teachers experience the problem posing process, what resources they utilize in this process, and what factors influence their decision-making. The semi-structured interview form provided the researcher with flexibility and the opportunity to examine teachers' thoughts in depth (Kvale & Brinkmann, 2009). In

this way, it was attempted to understand more comprehensively how teachers perceive problem posing processes, which strategies they use, and how they find solutions to the difficulties they encounter.

During the semi-structured interviews, an interview form consisting of pre-determined open-ended questions was used. This form was developed to be directly related to the research questions and was finalized after consulting with field experts. Participants were selected on a voluntary basis, and each interview was conducted individually in quiet environments free from distractions, where teachers could express themselves comfortably. The interviews lasted approximately 30-45 minutes and were recorded with a voice recorder after obtaining written consent from the participants. During the interviews, follow-up questions were asked when necessary based on the teachers' responses, thus ensuring that the responses were explored in greater depth.

The audio recordings were transcribed word for word by the researcher after the interviews and prepared for data analysis. During this process, participant confidentiality was strictly observed, and all data were anonymized with codes.

The semi-structured interviews guided the teachers on specific issues, while at the same time encouraging them to express their perspectives more broadly. This process allowed for a more comprehensive understanding of the strategies teachers used in problem posing, their learning experiences, their professional knowledge and how external factors were influential. It also provided important clues about the difficulties teachers faced in this process and their search for solutions, and what factors guided them in their decision-making. Such semi-structured interviews allowed teachers to better understand their professional experiences and provided in-depth insights into the problem posing process. Semi-structured interviews revealed how dynamic and multidimensional problem posing processes are based on teachers' individual experiences. This study aims to better understand teachers' problem posing processes and contribute to the literature on this critical dimension of mathematics teaching.

Data Analysis

The data collected in the study were analyzed using coding and constant comparative analysis techniques in accordance with the constructivist approach. The analysis process consisted of the following stages:

Open Coding: The data obtained from the interviews were analyzed line by line and the factors affecting mathematics teachers' problem posing processes were identified.

Axial Coding: The themes obtained in the open coding process were grouped and more general concepts were reached. For example, it was determined that teachers were influenced by factors such as pedagogical knowledge, student profile and curriculum.

Selective Coding: All the data were brought together to create a theoretical framework explaining teachers' problem posing processes.

Category Development: The data obtained were continuously compared with the previous data and the main categories affecting the problem posing processes were identified. In this process, different categories were created based on teachers' pedagogical approaches, experiences and environmental factors.

Various measures were taken to ensure the reliability of the codes and categories. Throughout the coding process, the data were carefully examined, and the participants' statements were analyzed

without being taken out of context. Each code and category was supported by direct participant statements and descriptive quotations. Using a continuous comparative analysis approach (Glaser & Strauss, 1967), each new piece of data was compared with previously obtained codes and categories, thus ensuring consistency. This process also involved the researcher continuously testing their interpretations against the data through self-reflection and becoming aware of possible biases. In addition, the analysis process of the research is explained in detail, allowing the reader to follow how the conclusions were reached. Since this study was conducted as part of a thesis research sub-problem, the data analysis process and findings were regularly shared with the advisor and thesis monitoring committee, thereby supporting the consistency of the analyses while maintaining scientific integrity and academic guidance. This has enhanced the reliability and traceability of the research (Charmaz, 2014).

Results

In this study, an answer to the question "Which factors affect mathematics teachers' problem posing processes involving real-life contexts?" was sought. As a result of the analysis, it was determined that the factors affecting these processes of mathematics teachers were divided into five subcategories. These sub-categories are; factors arising from the profile of the students, factors arising from the limitations and requirements of the curriculum, factors arising from the nature of the context, factors arising from the structural characteristics of the problem and factors arising from the competence of the teachers.

The frequencies and percentages of the factors related to students' profile, which is one of the factors affecting mathematics teachers' problem posing processes involving real-life contexts, are shown in Table 1. In addition, in order to reflect the views of the teachers more strikingly, they were supported with direct quotations.

Table 1. Frequency and Percentages Related to Factors Arising from Students' Profile

Factors arising from the profile of students	Frequency (f)	Percentage (%)
Academic level of students	11	30.6%
Students' interests	7	19.4%
Students' prior knowledge and experience	7	19.4%
Students' motivation and attitude	6	16.7%
Students' learning styles	3	8.3%
Cognitive development levels of students	2	5.6%

As seen in Table 1, students' academic levels, interests, prior knowledge and experiences, motivation and attitudes, learning styles and cognitive development level are among the main factors that teachers take into account in problem posing processes. These factors can directly affect the content, context and difficulty level of the problem posed by teachers. Among the factors arising from the profile of the students, the most emphasized factor by the teachers was the academic level of the students with 30.6% (f=11). SSMT-3 *"There are students with very different academic levels in the class. When writing a problem, it can be very easy for some and very difficult for others. It is really difficult to find a balance that appeals to everyone."* and HSMT-2 *"There are some students in the class who are very good academically and some who are not very good at mathematics. When I write a problem, I try to make it suitable for everyone, but sometimes it is either too easy or too difficult. It is really hard to find the middle ground."* emphasized that they paid attention to the academic level of the students. In addition, students' interests (19.4%; f=7), prior knowledge and experience (19.4%; f=7), and motivation and attitudes (16.7%; f=6) were among the factors frequently mentioned by the teachers. SSMT-2 *"When I create problems based on topics that interest students, they participate more in the lesson. But since each student's interests are different, sometimes I have*

difficulty in deciding which context I should choose." and SSMT-10 *"I want to relate mathematics problems to daily life, but each student's interests are different. Some of them like sports, some of them are interested in technology, some of them are interested in art. When I choose a single context, some students are not interested in the subject."* with their statements, they emphasized that the interests of the students affected the subject. HSMT-3 stated that *"I try to make a problem related to real-life, but sometimes students have difficulty in understanding because they do not even know the basics. I need to take their past experiences into consideration first."* and SSMT-5 *"I want to relate mathematics problems to daily life, but each student's interests are different. Some like sports, some are interested in technology, some are interested in art. When I choose a single context, some students are not interested in the subject."* with their statements, they emphasized that students' prior knowledge and experiences affect them. Considering the motivation and attitude of the students, SSMT-2 said, *"If the students are not eager for the lesson, they are not interested even if I give them the most interesting problem. Therefore, I need to make an introduction that will increase their motivation first."* and SSMT-*10 "Some students focus on the problem immediately, but some give up before even reading the first sentence, saying 'Teacher, it is too hard!'. I need to make the problem more interesting to motivate them."* On the other hand, the least emphasized factors by the teachers were students' learning styles (f=3) and cognitive development levels (f=2) with 8.3% and 5.6% respectively. SSMT-8 *"Some students read the problem and start solving it immediately, while others want to discuss it first. Since everyone's learning style is different, I try to diversify instead of giving a single type of problem."* with her statement, she emphasized that students' learning styles affect learning styles. HSMT-1 said, *"Sometimes I create a problem from daily life, but it is abstract for students. I realized that I should first take their cognitive level into consideration and choose a context at a level they can understand."* and SSMT-4 *"When I give a problem related to real-life, sometimes students cannot fully grasp the subject. I realized that I should choose more concrete situations that they can encounter in daily life, especially for younger students. Otherwise, the problem becomes incomprehensible for them."* emphasized that students have different levels of cognitive development.

The frequencies and percentages of the factors related to the limitations and requirements imposed by the curriculum, which is one of the factors affecting mathematics teachers' problem posing processes involving real-life contexts, are shown in Table 2. In addition, in order to reflect the views of the teachers more strikingly, they were supported with direct quotations.

Table 2. Frequency and Percentages Related to the Factors Arising from the Curriculum

Factors arising from the curriculum	**Frequency (f)**	**Percentage (%)**
Content coverage	14	42.4%
Learning outcomes	9	27.3%
Textbooks and resources	6	18.2%
Evaluation criteria	4	12.1%

When Table 2 is analyzed, it is seen that the learning outcomes, content scope, assessment criteria, textbooks and resources determined by the curriculum directly direct teachers' problem posing process. These factors can either restrict teachers' creative and flexible problem posing approaches or direct them within certain frameworks. Among the factors arising from the curriculum, the teachers mostly mentioned the factors related to the content scope (f=14) with 42.4% and learning outcomes (f=9) with 27.3%. SSMT-2 *"Sometimes I want to create very good problems that are related to real-life, but when I go beyond the topics in the curriculum, it is seen as a waste of time. That's why I always stay within a certain framework."* and SSMT-1 *"It is not possible to go beyond the topics specified in the curriculum. Therefore, even though I sometimes want to construct an interesting problem that is more related to daily life, I have to stay within the framework set by the curriculum."* with their statements, they emphasized that it should be appropriate to the content scope. SSMT-4 said, *"The problem I prepare must meet the learning outcomes in the curriculum.*

Even if I want to try something different on my own, if it is not directly related to the learning outcomes, it is not accepted." and HSMT-6 *"I have to look for compliance with the learning outcomes in the curriculum in every problem. No matter how interesting a problem is, if it does not support the learning outcomes, it is seen as a waste of time in the lesson."* with their statements, they emphasized that it should be in accordance with the learning outcomes. Among the factors arising from the curriculum, the least repeated factors are evaluation criteria (f=6) and textbooks and resources (f=4) with 18.2% and 12.1% respectively. SSMT-2 *"I want to give more creative, open-ended problems to students, but there are problems in evaluation. Because we are usually asked to score on questions where only one correct answer is expected."* emphasized that she paid attention to the evaluation criteria. Similarly, SSMT-7 said, *"We mostly use textbooks as a source, but most problems are very classical and disconnected from real-life. I want to turn to different sources, but the time and materials we have do not allow us to do so."* emphasized that textbooks and sources affect the assessment criteria.

The frequencies and percentages of the factors related to the nature of the context, which is one of the factors affecting mathematics teachers' problem posing processes involving real-life contexts, are shown in Table 3. In addition, in order to reflect the views of the teachers more strikingly, they were supported with direct quotations.

Table 3. Frequency and Percentages Related to the Factors Arising from the Nature of the Context

Factors arising from the nature of the context	**Frequency (f)**	**Percentage (%)**
Realism of the context	19	40.4%
Appeal of the context to students	13	27.6%
Cultural appropriateness of the context	9	19.1%
Context being interesting	6	12.8%

As seen in Table 3, the realism, appeal to students, cultural appropriateness and interestingness of the context within the problem directly shape teachers' problem posing process. Providing a context that is meaningful and interesting for students allows the problem posing process to gain depth and students to actively participate in the process, while an overly complex or limiting context may increase the cognitive load and negatively affect the effectiveness of the process. Among the factors arising from the nature of the context, the most repeated factor was the realism of the context with 40.4% (f=19). The HSMT-2, who thinks that the context should be realistic in the problem, said: *"Sometimes I give a situation as a problem that students may not encounter in daily life and they immediately ask, 'Can this really happen?' If the context is not realistic, the problem immediately feels artificial and they lose interest."* Among the factors arising from the nature of the context, the other factors that were mostly repeated were the appeal of the context to the students (f=13), cultural appropriateness (f=9) and being interesting (f=6) with 27.6%, 19.1% and 12.8% respectively. HSMT-4 *"I need to use a context that captures them to make them interested in the lesson. For example, when I give a problem about finance to a class interested in sports, it is not very effective. But when I choose a context related to soccer or basketball, they are more enthusiastic."* and SSMT-13 *"When I do not choose a context suitable for the age group and interests of the students, solving the problem is like an obligation for them. But if I choose a topic from their daily life, I immediately attract their interest."* emphasized that the context of the problem should appeal to the students. SSMT-11 "*Once I gave a problem based on a habit abroad, and the students did not understand it at all. Therefore, I now take care to choose contexts that are appropriate to the culture in which students live. Problems that are not close to their life world do not attract their interest."* and SSMT-8 *"Once I set up a problem about a payment system that is common abroad, but the students did not understand it at all. The context needs to be appropriate to their environment and culture, otherwise the problem loses its meaning for them."* with their statements, they emphasized that the context should be appropriate to cultural norms. HSMT-6, who thinks that the context of the problem should be

interesting, said *"If the problem is based on an ordinary and boring subject, students do not want to solve it. But when I choose a context related to technology, social media or current events, I immediately attract their attention. Fun and intriguing contexts are always more effective."*

The frequencies and percentages of the factors related to the structural features of the problem, which is one of the factors affecting mathematics teachers' problem posing processes involving real-life contexts, are shown in Table 4. In addition, in order to reflect the views of the teachers more strikingly, they were supported with direct quotations.

Table 4. Frequency and Percentages Related to the Factors Arising from the Structural Characteristics of the Problem

Factors arising from the structural characteristics of the problem	**Frequency (f)**	**Percentage (%)**
Clarity and explicitness of the problem	7	36.8%
Difficulty level of the problem	7	36.8%
Giving necessary information	2	10.5%
Relation of the solution to real-life	2	10.5%
Language used in the problem	1	5.3%

When Table 4 is analyzed, structural factors such as the language of the problem, its clarity, level of difficulty, the relationship of its solution with real-life and the provision of necessary information in the problem are important factors that guide teachers' problem formulation process. The problem should be appropriate to the level of the students, contain a meaningful mathematical relationship and be structured in a way to support the solution process. Structural factors such as the multi-stage nature of the problem, its openness to different solutions, or the adequacy of the data required for the solution can directly affect teachers' decisions. Among the factors arising from the structural features of the problem, teachers mostly mentioned the clarity of the problem (f=7) and the level of difficulty (f=7) with 36.8%. SSMT-12 *"Sometimes, when I set up a problem, everything seems very clear to me, but students have difficulty in understanding it. It is really important to clearly express what the problem is asking for, otherwise they can get lost in the solution process."* and SSMT-7 *"Sometimes when I write the problem, everything seems very clear to me, but students have difficulty in understanding what the problem is asking for. Especially when we use long and complex sentences, students are reluctant to solve the problem from the very beginning."* while emphasizing that the problem should be clear and precise, SSMT-8 *"It is not easy to find the appropriate level of difficulty for students. If it is too simple, they get bored, and if it is too difficult, they give up immediately. If I cannot find a balanced level, the problem becomes either too challenging or unnecessary for the students."* and HSMT-1 *"When I write a problem, I always ask myself this question: 'Will this question make students think or intimidate them? Because sometimes students actually give the answer with their facial expressions at the beginning of the problem. If I lose them from the beginning, no matter how well the problem is constructed, it is useless. That's why I try to prepare difficult but accessible problems."* emphasized that they paid attention to the difficulty level of the problem. The relationship of the problem solution with real-life, the language used in the problem and providing the necessary information about the problem were the least emphasized factors by the teachers with 10.5%, 5.3% and 10.5% respectively. SSMT-14 *"I choose a context from real-life, but sometimes students do not understand why this is important; when I do not concretize the relationship of the solution with daily life, the problem becomes just an ordinary activity based on operations in their eyes."* and HSMT-9 *"At the end of the problem, there are students who ask 'Well, what is this useful for? If I don't show how to apply it to a real-life situation in the solution, the problem is just a math exercise for them."* with their statements, they emphasized that the problem solution should be related to real-life. After giving the necessary information in the problem SSMT-2 *"When students are*

trying to solve the problem, they may ask, 'Do we need to know something else to solve this question?' This question usually shows that I have not structured the question well enough. Either I am giving too much data or I am missing a critical detail. The information given in the problem should definitely be sufficient and consistent for students to develop a solution. While unnecessary information can cause confusion, missing information can block the way to the solution." and HSMT-4 *"Students sometimes ask, 'Teacher, do we need any other information to solve this question? So, either I gave incomplete information or I created confusion with too much information. It is really important to give the right amount of information."* HSMT-7 stated, *"I pay attention to using mathematical concepts correctly, but sometimes students have difficulty in understanding the problem due to the complexity of the language. I realized that I should use a simpler and clearer language."* with this statement, he emphasized that attention should be paid to the language used in the problem.

The frequencies and percentages of the factors related to teachers' competence, which is one of the factors affecting mathematics teachers' problem posing processes involving real-life contexts, are shown in Table 5. In addition, it was supported with direct quotations to reflect the teachers' views more strikingly.

Table 5. Frequency and Percentages Related to the Factors Arising from Teachers' Competence

Factors arising from teachers' competence	Frequency (f)	Percentage (%)
Teachers' openness to innovative teaching approaches	19	50%
Teachers' expertise in mathematics	9	23.6%
Teachers' experience in problem posing	6	15.8%
Teachers' pedagogical knowledge	4	10.5%

As seen in Table 5, the teacher's pedagogical knowledge, expertise in mathematics, experience in problem posing and openness to innovative teaching approaches directly affect the quality of the problems posed. Among the factors arising from teachers' competence, the most repeated factor was the teacher's openness to innovative teaching approaches with 50% (f=19). HSMT-3 *"Students are now more prone to different methods and technology. Traditional problem posing methods sometimes do not interest them much. If I am not open to new approaches as a teacher, it becomes more difficult to attract students to the lesson."* and HSMT-8 *"Constructing a problem in a way that attracts students' interest is no longer only about how I as a teacher explain the subject, but also about how I interpret the world. If I am not open to new ways of thinking and different ways of problem posing, students' active involvement in the learning process is very limited."* with these statements, they emphasized that teachers should be open to innovative teaching approaches. In addition, the teacher's expertise in mathematics (f=9), experience in problem posing (f=6) and pedagogical knowledge (f=4) were among the frequently mentioned factors with 23.6%, 15.8% and 10.5% respectively. HSMT-7 *"If I do not fully understand the mathematical content, the problem I create is either incorrect or loses its meaning. Knowing the concepts in depth enables me to construct sound and consistent problems."* and HSMT-5 *"Some problems require deeper mathematical knowledge than I thought. If I do not fully grasp the subject, I may hesitate when students ask a question. Therefore, my own mathematical knowledge should be strong when I construct problems."*, while the teacher's mathematical content knowledge was emphasized with the statements HSMT-5 *"At first, I had a lot of difficulty in constructing problems, I was indecisive about what would be related to real-life. But over time, I learned to choose better contexts and started to write problems that attracted students' attention."* and SSMT-4 *"It is not always easy to construct problems related to real-life. At first, I was always taking examples from textbooks, but over time, I started to be more creative as I created my own problems. I feel that I have reached better problems as I gain experience."* with their statements, they emphasized the teacher's problem posing experience. Those who think that the pedagogical knowledge of the teacher is influential SSMT-11 *"If I cannot analyze the level of the students well, the problem I set up is either too easy or too difficult. It is really hard to write a problem with a real-life*

context without understanding how they think." and HSMT-8 *"How to present a problem, how to guide it is very important. It is not enough to just write the problem, it is necessary to explain it in a way that the student can understand, and to guide them with the right questions. Sometimes even if I give the best problem, it is not effective if I cannot explain it correctly."*

Discussion, Conclusion and Recommendations

Problem posing involving real-life contexts is a very important skill for mathematics teachers and it enables students to learn mathematical concepts in a more meaningful way. However, this process is affected by many factors. In this study, it was found that mathematics teachers' problem posing processes involving real-life contexts were shaped by five main factors. The main factors identified within the scope of the research are factors arising from the profile of the students, factors arising from the limitations and requirements of the curriculum, factors arising from the nature of the context, factors arising from the structural characteristics of the problem, and factors arising from the teachers' competencies. These findings support previous studies in the literature and reveal that the difficulties faced by teachers in creating real-life problems are not only due to personal skill deficiencies, but also due to the structural limitations of the education system and teachers' educational beliefs.

Students' academic levels, interests, prior knowledge and experiences were found to have a significant impact on teachers' problem posing processes. This finding was also reported by Schoenfeld (2013) and Büchter and Leuders (2005). It is frequently emphasized in the literature that teachers should use more concrete contexts when students' mathematical experiences are limited, while the context can be more abstract when students have higher levels of abstraction skills. Liljedahl (2019) found that teachers' difficulties in selecting appropriate contexts for students stem from differences in students' cognitive development levels. Students' prior knowledge, experiences, and problem-solving abilities can directly influence which contexts teachers choose. It can be said that teachers need more professional training and guidance to be able to select appropriate contexts according to the different needs of students.

In the study, it was found that some factors arising from the curriculum were determinative in teachers' mathematical problem posing processes. Among these factors, the content of the curriculum is a determining factor in teachers' problem posing process. In the problem posing process, it was observed that teachers generally created problems in accordance with the topics and learning objectives emphasized in the curriculum. Hiebert and Grouws (2007) emphasized that the comprehensive presentation of mathematical concepts in the curriculum enables students to understand these concepts. Çilingir-Altıner (2021) stated that the clarity of learning outcomes enabled teachers to be more goal-oriented in the problem-posing process. It was also found that teachers had difficulties in constructing problems based on real-life contexts due to the limitations of the curriculum. This situation was also emphasized by Blum and Borromeo Ferri (2009) in the literature. In this study, it was observed that the focus of the curriculum on abstract mathematical concepts made it difficult for teachers to include applied mathematical problems that are related to daily life. Revising the curriculum in this respect may make teachers' work easier and create more meaningful learning opportunities for students. Moreover, the flexibility of the curriculum may allow teachers to more effectively integrate problems based on real-life contexts into the teaching process.

The nature of the context is another important factor that teachers face in problem posing processes. In the research, it was stated that contexts that attract students' attention improve their problem solving skills and provide a more meaningful learning experience. Schoenfeld (2023) stated

that mathematical contexts that attract students' attention increase their motivation and commitment to the course and provide deeper learning. In this study, teachers sometimes experienced ambiguity in determining how much to use a context that is related to daily life when constructing problems. In the study, it was found that some of the teachers had reservations that the contexts were too abstract, while others had reservations that they were too concrete. Büchter and Leuders (2005) found that teachers prioritized the explicit reflection of mathematical content in context selection, while Chapman (2013) found that teachers gave more importance to the relationship of context to students' lives and its motivating quality. These different perspectives directly affect the approaches that teachers adopt in problem posing processes. While teachers pay attention to the level of students and the mathematical accuracy of the context, they may have difficulties in determining how much the context should be connected to daily life. Therefore, providing teachers with resources and examples to guide them in context selection can reduce this uncertainty. It can be concluded that teachers need more guidance in context selection.

Structural features of the problem are another important factor that teachers take into account when creating mathematical problems. This factor is related to the clear and precise expression of the problem, the language used in the problem, the difficulty level of the problem, the information required for problem solving, and how compatible the problem solution is with real-life. In the study, it was stated that the difficulty level of the problem positively affected the learning process when it was prepared in accordance with the current knowledge and skill levels of the students. Sullivan et al. (2015) emphasized that it is important for teachers to design tasks with appropriate difficulty levels in order to increase students' participation in mathematics lessons. This is a critical step to support students' problem solving skills. In this study, it was found that teachers' presenting all the necessary information included in the problem to students in a clear and understandable way enabled students to be more effective and successful in the solution process. Hiebert and Grouws (2007) stated that providing incomplete or unnecessary information during the problem posing process negatively affects students' mathematical understanding and this phenomenon decreases students' motivation to solve problems. Cai (2022) found that by providing the necessary information during the problem posing phase, teachers enable students to develop a clear road map for the solution process. In addition, in the study, it was observed that teachers found multi-stage problems more interesting and instructive, but that creating such problems was time-consuming. In their study, Blum and Borromeo Ferri (2009) stated that teachers should prefer problems that allow different ways of solution. This enables teachers to provide students with a variety of solution strategies to develop their mathematical thinking skills. However, the complexity of the problem structure can pose a challenge for teachers. Therefore, training materials and sample problems can be provided to teachers to help them develop more effective problem posing skills.

Teachers' competencies are the most determining factor in constructing problems involving real-life contexts. In this study, it was observed that teachers' openness to innovative teaching approaches and high levels of mathematical knowledge are positive factors for effective problem posing processes and contribute positively to problem posing skills. Ayaz and Şekerci (2015) stated in their study that teachers' having innovative teaching approaches increased students' interest in the lesson. Peng, Li, Lin, Cao and Cai (2022) found that mathematics teachers' deep mathematical knowledge contributed to teachers' more effective mathematical problem posing. In this study, it was revealed that experienced teachers were more competent in the problem posing process and managed these processes more effectively. In his study, Divrik (2023) stated that as teachers gain experience, they are able to develop more effective strategies in problem posing processes and prepare more effective problem

scenarios for students. In this article, it was also found that teachers' lack of pedagogical knowledge about problem posing is one of the important obstacles they face in the process of creating real-life problems. In their study, Blum and Borromeo Ferri (2009) observed that teachers' inadequacies in pedagogical knowledge made effective problem posing difficult and limited their ability to relate mathematical concepts to daily life. Teachers who perceive mathematics only as an abstract and rule-based discipline distance themselves from problem posing processes that are associated with real-life. This may limit students' ability to relate mathematics to daily life and negatively affect their learning motivation and meaning-making (Boaler, 2016). In addition, teachers' limited resources and difficulties in time management may make problem posing processes more complex. As a result, it is revealed that in order for teachers to develop these skills, they need professional development programs that include practical trainings, workshops, and interactive learning environments based on experience sharing among teachers. Therefore, it is important to provide trainings and supporting materials that will increase teachers' competencies.

This study revealed that mathematics teachers' processes of constructing problems involving real-life contexts have a multidimensional structure and that these processes are affected by various factors. Many factors ranging from the profile of the students to the limitations of the curriculum, from the nature of the context to the structural features of the problem were identified as obstacles that teachers face in this process. In addition, teachers' competencies and pedagogical skills played a decisive role in problem posing processes involving real-life contexts. In this context, teacher trainings and professional development programs should be restructured in a way to improve teachers' ability to construct real-life problems. In these trainings, teachers should be provided with the necessary skills to construct problems involving real-life contexts more effectively. Teachers should be provided with resources and examples to guide them in context selection. In addition, the curriculum should be reorganized to allow teachers more flexibility to include mathematical problems that relate to daily life. Supportive educational materials and hands-on activities should be provided for teachers to develop mathematical and logical thinking habits. In conclusion, it is understood that not only individual skills but also the educational system and supporting structures play an important role for teachers to effectively construct problems involving real-life contexts. These findings suggest that a comprehensive approach is needed to improve teachers' educational processes and to provide their students with more meaningful, easy and lasting learning opportunities.

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Author Contributions

In this study, the authors' contributions to the research process are equal.

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Conflict of Interest

The authors have no conflicts of interest to declare.

Ethical Statement

This study was conducted in accordance with the approval of Gazi University Rectorate Ethics Committee on 21.03.2023, with reference number 05.