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# INVESTIGATING THE PROBLEM POSING REASONS OF PRE-SERVICE PRIMARY SCHOOL TEACHERS IN DIFFERENT PROBLEM POSING CONTEXTS

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**Abstract**

*The purpose of this study is to discover the problem posing reasons of pre-service primary school teachers in free, semi-structured and structured problem posing activities. In the first stage of the study, a problem posing task consisting of six problem posing situations (2 free, 2 semi-structured and 2 structured) was given to 40 participants (pre-service primary teachers in their sixth academic term). Each participant was given between 25 and 30 minutes to complete a task. After that the completion of the task, 10 of the pre-service teachers were selected for task-based interviews. These interviews were video recorded. The data obtained from the task-based interviews were analyzed using the content analysis method. According to the findings of the study, it can be concluded that several common problem posing reasons exist in different problem posing contexts. Although primary school student factor was the most common reason in all three problem posing contexts, the exam system, previous experience, emotional factors and the structure of the problem posing situation were other reasons that primary school pre-service teachers had posing problems. The reasons why pre-service teachers engaged in problem posing activities stem from their previous experience and also representation types of problem posing contexts such as table, picture and etc.*

***Key words:*** *Problem posing, reasons for problem posing, pre-service primary school teachers*

# SINIF ÖĞRETMENİ ADAYLARININ FARKLI PROBLEM KURMA DURUMLARINDAKİ PROBLEM KURMA NEDENLERİNİN ARAŞTIRILMASI

**Özet**

*Bu çalışmada sınıf öğretmeni adaylarının serbest, yarı-yapılandırılmış ve yapılandırılmış problem kurma durumlarındaki problem kurma nedenleri araştırmak amaçlanmıştır. Bu amaç doğrultusunda araştırmanın birinci aşamasında 6 (2 serbest, 2 yarı-yapılandırılmış ve 2 yapılandırılmış) problem kurma durumlarından oluşan bir problem kurma görevi toplam 40 sınıf öğretmeni adayına uygulanmıştır. Öğretmen adaylarının bu görevi bitirmeleri için onlara 25-30 dakika arasında süre verilmiştir. Bundan sonra belli ölçütleri sağlayan ve gönüllü olan toplam 10 sınıf öğretmen adayı klinik görüşme için seçilmiştir. Klinik görüşmeler video kamera aracılığıyla kayıt altına alınmıştır. Klinik görüşmelerden elde edilen veriler, içerik analizi tekniği kullanılarak analiz edilmiştir. Araştırmadan elde edilen sonuçlara bakıldığında farklı problem kurma durumlarında problem kurma nedenlerinden bazılarının ortak olduğu görülmüştür. İlköğretim öğrenci faktörü her bir problem kurma durumunda ortak olmasına rağmen, sınav sitemi, önceki deneyim, duygusal faktörler ve problem kurma durumunun yapısının farklı problem kurma durumlarında ortaya çıktığı görülmüştür. Problem kurma durumlarının yapısının farklılık göstermesi ve öğretmen adaylarının önceki yaşantılarının problem kurmayı etkileyen faktörler olduğu düşünülmektedir.*

**Anahtar Kelimeler:** *Problem kurma, problem kurma nedenleri, sınıf öğretmeni adayı*

**Introduction**

In mathematics, education problem solving is an important topic and it is assumed that if a person solves mathematical problems correctly, then he could easily solve other problems that he might encounter in daily life. For this reason, problem solving is an essential part of the mathematics curriculum and the documents related to mathematics (MEB, 2009; NCTM, 2000).

Problem solving has many different components, including problem posing. In the last two decades, problem posing activities have been investigated by researchers and educators. Studies about problem solving have shown that mathematical problem solving achievements and problem posing performances are closely related to each other. Problem posing involves the generation of new problems and questions in order to explore a given situation, as well as the re-formulation of a problem during the course of solving it (Silver, 1994). Problem posing is defined as the creation of new problems or the re-formulation of a given problem (Ticha & Hospesova, 2009).

Problem posing in mathematics education provides opportunities for both educators and researchers. It can be used as a tool for investigating different nuances of the students' understanding of mathematics (Stoyanova, 2003) as well as for developing and strengthening critical thinking skills of students (Nixon-Ponder, 1995) as task allow a teacher to gain insight into the way that students construct mathematical understanding and, therefore, serve as a useful assessment tool (Lin, 2004).

Within the literature there exists a strong emphasize on the development of problem posing abilities of students. In Turkiye, problem posing activities have been performed since 2005 in the learning areas of the mathematics curriculum. The most recent Turkish Primary School Mathematics Curriculum (grades 1-5) contains problem posing activities in each of the grades. For example, it emphasizes the ability to construct problem posing by using mathematical and daily life applications (MEB, 2009).

Problem posing can be used for many reasons including leading to the development of pedagogical content knowledge in mathematics education in regard to the pre-service training of primary school teachers (Ticha and Hospesova, 2009) and can have a impact on teachers' beliefs about mathematics and its instruction (Barlow and Cates, 2006). It can also have a positive impact on pre-service teachers' knowledge and views about what it means to mathematics (Toluk-Uçar, 2009).Many tasks are used within the literature to analyze problem posing performances and, as such, different aspects of how to understand of the problem posing process are identified. Stoyanova and Ellerton (1996) identified three different situations in which problems can be generated: a) free situations, b) semi-structured situations and c) structured situations. In free problem posing situations, students are asked to generate a problem from a given situation. That situation could involve general directions such as 'make up a difficult problem. In a

structured problem posing situation, students are given an open situation and invited to explore the structure or to finish it using their knowledge, skills, concepts and relationships from their previous mathematical experiences. Semi-structured problem posing situations include posing problems from pictures, equations and inequalities (Stoyanova, 2003).

Several ways exist as to how to classify problem posing. According to Silver and Cai (1996), problem posing can be classified according to whether it takes place before, during or after problem solving. Christou et al. (2005) classified problem posing situations based on the study of Stoyanova and Ellerton (1996). Their model incorporated forms of semi-structured and structured situations. They described their model using four processes: editing, selecting, comprehending and translating. In the editing process, the quantitative information is mostly associated with tasks that require students to pose a problem without any restrictions. In the selecting process, quantitative information is associated with tasks that require students to pose problems or questions appropriate to specific, given answers. In the comprehending process, the quantitative information refers to tasks in which students pose problems from given mathematical equations or calculations. In the translating process, the quantitative information requires the students to pose appropriate problems or questions from graphs, diagrams or tables (Christou et al., 2005).

Korkmaz and Gür (2006) emphasized that if we want to improve students' problem posing abilities, first of all we should improve preservice teachers' problem posing abilities. Not many previous studies have focused on problem posing reasoning research conducted with pre-service teachers. For this reason, this study focuses on pre-service teachers' problem posing reasons in free, semi-structured and structured problem posing activities. Different problem posing activities were chosen in order to determine whether the reasons for problem posing change in accordance with different problem posing contexts. The investigation of the factors that cause pre-service teachers to set up problems is important because understanding pre-service teachers' reasons for posing problems will allow researchers to understand their perceptions of problem posing and help teacher educators review their educational activities. Therefore, this type of research contributes to both educators and researchers.

**Method**

The main qualitative research method used within this study was the task-based interview as it allows researchers to easily understand the participants' reasons as to why they posed certain problems.

**Participants**

The criterion sample strategy was used to choose the participants in this study (Patton, 1990). Each of the participants was a student in the primary teacher education department enrolled in the Mathematics Instruction I and II courses.

They also needed to be in their sixth semester of education. The participants were split evenly by gender (five male and five female). In order to protect the identities of the students, codes were used in place of their names (Patton, 2002). For the females, the following codes were used: PG1, PG2, PG3, PG4 and PG5. For the males, the following codes were used: PB1, PB2, PB3, PB4 and PB5. The researcher was coded as R.

**Data collection procedure**

Methods provided in studies published by Stoyanova and Ellerton (1996) and Christou et al. (2005) were used for the data collection in this study. Each participant completed a problem posing task consisting of six problem posing situations. Each problem posing task was constructed using two free, two structured and two semi-structured problem posing activities. Each participant had 30 minutes to complete the task. After completing the task, 10 participants were selected for the task-based interviews. A pilot study was conducted using one participant in order to check the task-based interview questions and the task for comprehensibility.Each interview took between 25 and 30 minutes. During the interview, the participants were asked to explain why they posed certain problems in order to understand their reasoning. As suggested by Hunting's study (1997), the interview questions were open-ended allowing the students freedom in regard to choosing their methods of responding. Some of the interview questions included *"Could you tell me what are you thinking?" "Why did you pose that problem?"* and *"What are the reasons for posing that problem?"*Each interview was video taped. After the interview, one expert checked the items in the task for content validity. For reliability, the agreement /agreement +disagreement x100 formula was used and consistency was calculated to be 90% (Miles and Huberman, 1994) and it was found %92

**Data analysis**

The transcripts of the interviews were analyzed using the content analysis method (Yıldırım and Şimşek, 2005). The participants' problem posing responses were analyzed under the free, structured and semi-structured codes. The data analysis consisted of four sequential phases. After the data collection process, the interviews were transcribed verbatim. Then, the researcher read the interview transcripts. Third, the data was selected and coded according to the three problem posing situations and their sub-categories. Finally, the data was placed in a table. In order to confirm the validity and reliability of the study as well as the long-term interaction with the participants, expert scrutiny, participant confirmation, detailed descriptions, purposeful sampling and confirmation scrutiny were implemented (Yıldım and Şimşek, 2005).

**Results**

The reasons of pre-service teachers were handled severally and the reasons were given in Table 1

**Table 1:** *Pre-service teachers' problem posing reasons.*

| Problem posing situations | | Problem posing reasons | Participants |
|---|---|---|---|
| Free problem posing | Posing a difficult problem | Previous experience | $P_{G5}$ $P_{B1,}$ $P_{B2}$ |
| | | Student | $P_{B2,}$ $P_{B3}$ |
| | | Teacher | $P_{G3}$ |
| | | System of exam | $P_{G2,}$ $P_{G3,}$ $P_{G4,}$ $P_{B2}$, $P_{B5}$ |
| | | Emotional factor | $P_{G1}$, $P_{B4}$ |
| | Posing a problem related to fraction | Previous experience | $P_{G1}$, $P_{G5,}$ $P_{B1,}$ $P_{B2,}$ $P_{B3,}$ $P_{B4}$ |
| | | Student | $P_{G1}$, $P_{G2,}$ $P_{G3,}$ $P_{B2,}$ $P_{B3}$ |
| | | System of exam | $P_{G4,}$ $P_{B2,}$ $P_{B5}$ |
| | | Emotional factor | $P_{G5}$ |
| | | Information resources Internet | $P_{G2}$ |
| | | Structure of fractions | $P_{G3}$ |
| Semi-structured problem posing situations | Editing (posing a problem based on a picture) | Student | $P_{B1,}$ $P_{B2,}$ $P_{B3}$ |
| | | System of exam | $P_{B4}$ |
| | | Daily life applications | $P_{G2,}$ $P_{G5,}$ $P_{B1}$ |
| | | Structure of problem posing Givens | $P_{G1}$, $P_{G4,}$ $P_{B5}$ |
| | Translating (posing a problem based on a table) | Previous experience | $P_{B1}$ |
| | | Student | $P_{G3,}$ $P_{G4,}$ $P_{G5,}$ $P_{B1,}$ $P_{B2,}$ $P_{B3}$ |
| | | Daily life applications | $P_{G4,}$ $P_{G5}$ |
| | | Structure of problem posing Focusing on given | $P_{G1}$, $P_{G2,}$ $P_{B2,}$ $P_{B5}$ |
| Structured problem posing situations | Comprehending posing problem based on a table) | Student | $P_{G3,}$ $P_{G4,}$ $P_{G5,}$ $P_{B1,}$ $P_{B2,}$ $P_{B3}$ |
| | | Previous experience | $P_{G2}$ |
| | | Daily life applications | $P_{G2,}$ $P_{G5,}$ $P_{B1}$ |
| | | Structure of problem posing Numbers in equation | $P_{G1}$, $P_{G3}$ |
| | | Emotional factor | $P_{G4,}$ $P_{B3}$ |
| | Selecting (posing a problem based on a history) | Student | $P_{G3,}$ $P_{G5,}$ $P_{B1,}$ $P_{B3}$ |
| | | Emotional factor | $P_{B3,}$ $P_{B4}$ |
| | | Structure of problem posing Focusing on result | $P_{B1}$ |
| | | Focusing on given | $P_{G1}$, $P_{G2,}$ $P_{B5}$ |

***Reasons for posing problems in free problem posing contexts***

***Posing a difficult problem***

The reasons why pre-service teachers posed difficult problems were their previous experience, their teacher, the exam system, student, information resources used and an emotional factor. Examples for each of these factors are given below. For previous experience, the opinions of participant $P_{B3}$ can be given as an example.

*R: What is the reason for posing that kind of problem?*

*$P_{B3}$: I always had difficulty with that kind of question. I took a pencil and drew it.*

Two of the participants stated that they considered primary school students while posing their problems. Participant $P_{B2}$ stated that *"students also have difficulties with percentage problems, so while working on the problem, I thought of the students."*

Participant $P_{G3}$ stated that her teacher was one of the reasons she chose to pose her problem.

Five of the participants stated that their problems were affected by the exam system. For example, participant $P_{B5}$ stated that *"I think that tests affect my problem posing because I had typical test*" Participant $P_{B2}$ declared that *"While I was posing that problem, a problem from my university entrance exam came to my mind. When I solved it, I did not understand it."*

Participants $P_{G2}$, $P_{G3}$ and $P_{G4}$ said that they wrote a problem that they had encountered on previous exams.

Participants $P_{G1}$ and $P_{B4}$ said that emotional factors influenced the types of problems they posed.

***Posing fraction problems***

As seen in Table 1, six of the participants' discussed their previous experiences as their reasons for posing problems about fractions. For example, participant $P_{G5}$ said, *"I constructed that problem based on my experience,"* while participant $P_{B3}$ said, *"First of all, I started to pose a fraction problem focusing on my previous experience and issues. I mean, I have always had difficulties solving that kind of problem."* Participant $P_{B3}$ said, *"It was a classic problem; I solved it every time."*

Five of the participants posed problems in which they focused on issues faced by primary school students. Participant $P_{G2}$ mentioned that, *"I thought of the students and, therefore, tried to capture the attention of primary school students,"* while participant $P_{G3}$ declared, *"I wrote that kind of problem so that the students could solve it easily."* Participant $P_{B2}$ said, *"I thought that students would have difficulty solving the problem. That is the reason."*

Three participants said that the exam system was a factor in the problem they posed. The following is an excerpt from a task-based interview between the researcher and participant $P_{G4}$.

*R: How did you remember that problem and what is the reason for posing that kind of problem?*

*$P_{G4}$: OSS (university entrance exam); I encountered many problems like that as I studied for the OSS.*

Participant $P_{G5}$ considered an emotional factor when posing her fraction problem. She said, *"I tried to write a problem that was meaningful to me."*

Participant $P_{G2}$ indicated that her reason for posing her problem was the Internet. *"I looked at fraction examples on the Internet and, generally, I saw that kind of problem."*

Participant $P_{G3}$ indicated that structure was part of the reason she posed her problem. *"It says fraction, so* the *numbers 1/3 and 2/3 came to my mind."*

***Reasons for posing problems in semi-structured problem posing contexts***

***Editing***

Four of the participants took into account the primary school student when posing their problems. For example, participant $P_{G3}$ said, *"I wanted the students to compare family."* Participant $P_{B1}$ stated that *"I tried to construct a problem that student could used when attempting to harmonize the picture and problem."*

Daily life applications were seen another factor in posing a problem for participants $P_{G2}$, $P_{G5}$ and $P_{B1.}$ $P_{G5}$ said, *"The photo contains daily life content."* $P_{G2}$ said, *"When I looked at the photo, I saw daily life prices and a family trying to decide what to buy.*

Four of the participants stated that structure was their reason for posing their problems. For example, participant $P_{G1}$ said, *"First of all, I looked at the picture. I focused on picture and then something came to my mind."* Participant $P_{B5}$ said, *"Two families are shopping."*

***Translating***

Six of the participants posed problems that focused on problems encountered by primary school students. For example, participant $P_{B2}$ said, *"In fact, I tried to use addition and subtraction in the problem so that the students could easily understand and solve it."* Participant $P_{B3}$ declared that *"For instance, a student could use the table to interpret."*

Two of the participants indicated that daily life applications were their reasons for posing their problems. Participant $P_{G5}$ said *"I performed operations considering daily life applications. I wrote problems based on applications".*

Four of the participants mentioned that problem posing situation was reason for posing problems in the context of translating. Participant $P_{G1}$ said, *"First, I looked at the problem posing situation," while* participant $P_{B2}$ said, *"As mentioned*

*in the problem posing situation, I posed the problem using addition and subtraction as they are givens here."*

***Reasons for posing problems in structured problem posing contexts***

***Comprehending***

Six of the participants stated that their reasons for posing their problems in the structured problem activity were because they were focusing on the needs of the primary school student. For example,

*R: What was your reason for posing that kind of problem?*

*$P_{B1}$: So that the student can solve the problem easily.*

The emotional factor influenced two of the participants. Participant $P_{B4}$ said, *"That time it came to my mind, I wanted to pose road problem."*

Three of the participants stated that daily life applications were a major factor as to why they posed their problems. Participant $P_{G5}$ declared, *"I continued using currency. I mentioned a monthly salary. I talked about a family and her husband's salary. I subtracted spent money and calculated the rest of money and I signed as n*."

Two of the participants' stated that their reasoning was the magnitude of the numbers in the equation. Participant $P_{B1}$ said, *"I looked at the numbers in equation and they are so big. If I said sugar, it should not be, so I said animals, I considered animals in a farm.*"

***Selecting***

Four of the participants focused on issues that might face the primary school students in structured problem posing contexts. Participant $P_{B3}$ stated *"I considered the student and I thought that he or she might find it difficult."* Another example can be found below.

*R: Why did you pose that kind of problem?*

*$P_{G3}$: I tried to make it understandable so that the students could understand it easily and easily frame it in their minds.*

*R: Did you consider the students?*

*$P_{G3}$: Yes, I considered the students.*

*R: Why? Could you explain?*

*$P_{G3}$: I don't know. It may be my occupation. I always think of the students.*

The emotional factor was the reason cited by participants $P_{B3}$ and $P_{B4}$. Participant $P_{B4}$ said, *"The first thing that came to my mind, I don't know."*

The structure of problem posing was the reason given by participants $P_{G1}$, $P_{G2}$ and $P_{B5}$. They focused on givens in problem posing situation. For example, participant $P_{B1}$ stated that, *"There is a history situation, so I considered history. I*

*posed a problem that considering the situation."* Participant $P_{G2}$ said, *"There is addition and subtraction in the problem posing context and it directed me toward shopping."*

**Conclusion, Discussion and Suggestions**

Problem posing provides significant contributions to pre-service teachers (Barlow and Cates, 2006; Ticha and Hospesova, 2009; Toluk-Uçar, 2009) and students (Lin, 2004; Nixon-Ponder, 1995; Stoyanova, 2003). As problem posing activities are important in primary school mathematics and teacher education, it is important to learn the reasons why future teachers pose certain problems in certain contexts. Although it is not possible to guess what reasons lie under each problem posing decision, the results of this study show that for semi-structured and structured problem posing situations future teachers often consider the students, structure of the problem being posed, emotional factors and daily life applications. In free problem posing situation, the results showed that previous experience, the students, previous experience with exams and emotional factors influenced the types of problems posed by the pre-service primary school teachers.

The common denominator in all of the situations was the students. The pre-service primary school teachers probably most often took the student into consideration due to their profession. Reasons for the variations in the other reasons presented could stem from the ways in which the problems were represented, such as by picture or table.

Işık et al. (2011) conducted a study with pre-service mathematics teachers and discovered that the success of the pre-service teachers was generally low in regard to posing problems appropriate to different representations. Representation type of problem posing effects performance and reason for posing a problem. And also their previous experience can be effected their reasons for posing problems. An extended studies can be conducted with a large sample to understand reasons for problem posing.

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