# The Tendency of Turkish Pre-service Teachers' to Pose Word Problems

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**Abstract:** The aim of this study was to identify the problem posing tendency of preservice teachers (primary and mathematics) in structured problem posing situations. Participants were selected using a two-step sampling process in order to prevent bias. In the first sampling process, a total of 109 pre-service teachers participated in the study. Of these participants, 48 were pre-service primary school mathematics teachers and 61 were pre-service primary teachers who were in their sixth term of school. In the second sampling process, 10 volunteer participants were selected using purposeful sampling. It was found that participants had a tendency to pose result-centered problems (contextually inappropriate and irrelevant result-focused problems) and context-centered problems (standard and non-standard word problems). In some cases, participants did not pose any word problems.

**Keywords:** Problem posing, structured problem posing, word problem, pre-service primary mathematics teacher, pre-service primary teacher

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## 1. Introduction

There are many kinds of mathematical problems described in the literature. For instance, Souviney (1994) classified problems as routine story or word problems and nonroutine process problems. Holmes (1995) classified problems as routine and nonroutine problems. Word or story problems can be solved by applying previously learned concepts and skills, such as "Allan and Nick each bought the same stamp for their collection. Allan paid 14. Nick paid 1 more. How much did Nick pay for his stamp? Allan bought a stamp for 10 and sold it to Nick for 12. Later, he bought it back from Nick for 14 and resold it to another collector for 16. Did Allan make a profit on the transaction? If so, how much?" This nonroutine problem example cannot be solved by selecting and applying one or more operations as word problems; rather, solving this problem requires flexible thinking (Souviney, 1994). Literature regarding word problems is generally classified by researchers as standard and non-standard-problematic (parallel) problems (Kılıç, 2011; Olkun, Şahin, Akkurt, Dikkartın & Gülbağcı, 2009; Reusser & Stebler, 1997; Yoshida, Verschaffel & De Corte, 1997). Standard word problems are those that can be solved by applying the most obvious arithmetical operation(s) using the given numbers. The problem "A boat sails at a speed of 45 km/hr. How long does it take this boat to sail 180 km?" is an example of a standard word problem. This problem can be solved by applying an arithmetical operation. Non-standard word problems are those for which the appropriate mathematical models are less obvious and the mathematical modelling assumption is problematic. The problem "One runner's best time to run 100 meters is 17 s. How long will take to run 1000 meters?" is an example of a non-standard problem. This kind of problem can be solved by using arithmetical operations and it requires the solver to take real life knowledge into account in

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the context of the problem (Olkun et al., 2009; Reuseer & Stebler, 1997; Yoshida et al., 1997). Teaching both solving and posing these types of problems effectively is one of the duties of teachers.

**Framework for mathematical problem posing**

Christou, Mousoulides, Pittalis, Pitta-Pantazi and Sriraman (2005, p.149) stated that "Problem posing is an important aspect of both pure and applied mathematics and an integral part of modelling cycles which require the mathematical idealization of real world phenomenon." Based on the literature, there are different classification frameworks related to problem posing situations (Christou et al., 2005; Silver & Cai, 1996; Stoyanova & Ellerton, 1996). For instance, Silver and Cai (1996) classified problem posing situations according to whether they take place before, during, or after problem solving. Christou et al. (2005) classified problem posing situations into four processes, namely editing, selecting, comprehending, and translating. Furthermore, the well known framework proposed by Stoyanova and Ellerton (1996), which consists of free, semi-structured, and structured problem posing situations, is explained in more detail below:

- *Free problem posing situation:* students are asked to generate a problem from a given contrived or naturalistic situation. For instance "pose a problem for mathematics competitions or problem which you like can be given as an example of that situation."
- *Semi-structured problem posing situation:* range from situations incorporating unfinished structures to posing sequences of interconnected problems.
- *Structured problem posing situation:* a well structured problem or problem situation is given and the task is to construct new problems (Stoyanova, 2003).

Problem posing is very important mathematical activity because of its benefits. Problem posing is beneficial for developing students' mathematical skills and investigating their understanding of mathematics (Stoyanova, 2003), a tool for developing and strengthening critical thinking (Nixon-Ponder, 1995) related to creativity (Silver, 1994; Leung, 1997), important for the psychological and intellectual development of students (Rizvi, 2004) an assessment tool (Cai et al., 2012) and is one of the key components of mathematical exploration (Cai, 2003). Furthermore, problem posing allows teachers to understand the true capabilities of their students (Barlow & Cates, 2006). Teachers are responsible for laying the groundwork by preparing an effective problem posing environment. They should help students understand the stages of the problem posing process, such as describing the content, defining the problem, personalizing the problem, discussing the problem, and discussing alternatives to the problem by asking relevant and inductive questions (Nixon-Ponder, 1995).In Turkish primary mathematics curriculum, it is emphasized that while developing skills in problem solving, problem posing skills should also be developed using both mathematical and daily life applications (MoNE, 2009).

There are many benefits for pre-service teachers to generating problems. Tichá and Hošpesová (2009) indicated that problem posing is a method that contributes to the development of pedagogical content knowledge of mathematics in pre-service training of primary school teachersand influencing their views about what it means to understand mathematics (Toluk-Uçar, 2009), which might help to improve their mathematical content knowledge.It has been asserted in several studies that pre-service teachers have some issues related to problem posing activities (Korkmaz & Gür, 2006; Luo, 2009; Toluk-Uçar, 2009). For example, pre-service primary and mathematics teachers were found to pose word problems that were mainly derived from mathematics textbooks and were rarely creative problems (Korkmaz & Gür, 2006), pre-service elementary teachers were unable to construct appropriate word problems for the given symbolic expressions (Luo, 2009), and pre-service teachers had difficulty in generating a conceptually correct representation of the given statements (Toluk-Uçar, 2009). In previous studies regarding problem posing, structured problem posing situations were used to determine pre-service teachers' problem types (Goodson-Espy, 2009; Işık, 2011; Luo, 2009; Rizvi, 2004; Toluk-Uçar, 2009). However, sufficient information regarding pre-service teachers' word problem posing tendencies was not available, and that study was aimed to fill that gap in the literature by examining the ability of pre-service teachers to pose word problems based on different structured problem posing tasks.It also provides insights into the similarities and differences of pre-service mathematics and primary teachers' performance. Furthermore, considering that the problem posing actions of students can be nurtured by teachers' actions (Lowrie, 2002), it is important to understand pre-service teachers' tendencies of problem posing during teacher education as a means of educating them.As indicated in the study of Quinn (1997) teachers who have inadequate meaningful mathematical content knowledge and/or poor attitudes toward the subject often exacerbate the problems that students experience in learning mathematics. Chen et al. (2011, p.923) stated that "The completeness, correctness and coherence of both teachers' subject-matter knowledge and their pedagogical content knowledge impacts the nature and quality of their actual teaching and, consequently, of students'mathematical learning processes and outcomes." Therefore training of effective teachers is very important and thismay be with the help of theteacher training programs. For that reasons, this study aimed to determine pre-service teachers' problem posing tendencies during structured problem posing activities. The following questions were addressed: (a) What type of problems are posed by participants? and (b) are there any differences between pre-service primary mathematics teachers and pre-service primary teachers in terms of the posed word problems?

## 2. Method

In this study, data triangulation was considered by supporting its quantitative findings by using qualitative research methods. In triangulation-based research design, "the researcher simultaneously collects both quantitative and qualitative data, compares the results, and then uses those findings to see whether they validate each other" (Fraenkel & Wallen, 2005, p.443).This study enrolled 109 participants who took part in a structured problem posing situation. Then task-based interviews conducted with 10 volunteer participants. Task-based interviews for the study of mathematical behaviour involved a minimum of a subject and an interviewer who intereacted with each other during one or more tasks (questions, problems, or activities) that were introduced to the subject by the clinican in a pre-planned way (Goldin, 2000).

### 2.1. Participants

Participants were selected using a two-step sampling process in order to prevent bias. In the first sampling process, 109 pre-service teachers participated in the study. Of these participants, 48 were pre-service primary school mathematics teachers and 61 were pre-service primary school teachers. All participants were in their third class. All participants had enrolled in mathematics teaching method courses during their education. In all courses, participants were engaged problem types, problem solving and posing as topics separately. It was assumed that all participants had learned problem types, problem solving and posing skills at a basic level. In the second sampling process, 10 volunteer participants were selected using criterion sampling technique being one of thepurposeful sampling techniques. The criterion was attending mathematics teaching methods course and representing different patterns within the study related to categories emerged from the study. Five participants from each group were seleced. The real names of participants were kept confidential and nicknames were used such as Fırat, Sinem, etc.. The code “I” was used for the researcher conducting the interviews.

### 2.2. Data collection

The data of the study were collected during mathematics teaching methods courses. For data collection, participants were asked to create problems by considering a structured problem posing situation that had three different solutionsindividually during mathematics method course session and 45 minutes were allowed them to pose problems. The structured problem posing situation was as follows: *pose problems that belong to the numerical situation 100:8; solutions should be a)12 b)13, or c)12.5* (Chen, Dooren, Chen & Verschaffel, 2011). The 100:8 problem posing situation was chosen for this study because it has three different solutions, which allowed for the pre-service teachers to pose either standard or non-standard word problems, or both. This allowed for assessment of the situation and their word problem posing tendencies could be assessed effectively. Questions that were used in the task-based interviews were open-ended and allowed for assessment ofparticipants’ thinking processes (Hunting, 1997).The interviews with participants took between 20-25 minutes and were tape recorded.Interviews questions included the following:

- Can you explain how you posed the problem?
- Do you think that the problem is appropriate for the given problem posing situation?
- What is the problem posing situation that is given to you here?
- Can you explain what you thought while posing that problem?

### 2.3. Data analysis

First of all posed problems or situations by 109 participants were listed and coded using content analysis technique. Participant-posed problem tendencies were analyzed based on *result-focused problems* (RFP), which they had posed by only considering results and the problem posing situation and *context-focused problems* (CFP), which they had posed considering the problem posing situation and given solutions.Result-focused problems included other including no answer and non word problems. RFPs were analyzed to determine whether contextually inappropriate problems emerged, as in the study of Chen et al., (2011). CFPs were analyzed for either non-standard word problems or standard word problems. After coding, the percentage ofproblemtypesand frequency of distributionswere calculated and presented in Table 1.

After the interviews, the records obtained from the participantswere transcribed verbatim by the researcher. As the next step, transcripts were analyzed using the Miles and Huberman (1994) data analysis model, which consisted of three phases: data reduction, data display, and conclusion drawing/verification. In the data reduction phase, the researcher coded the data that were considered to be important concepts and patterns for the study.

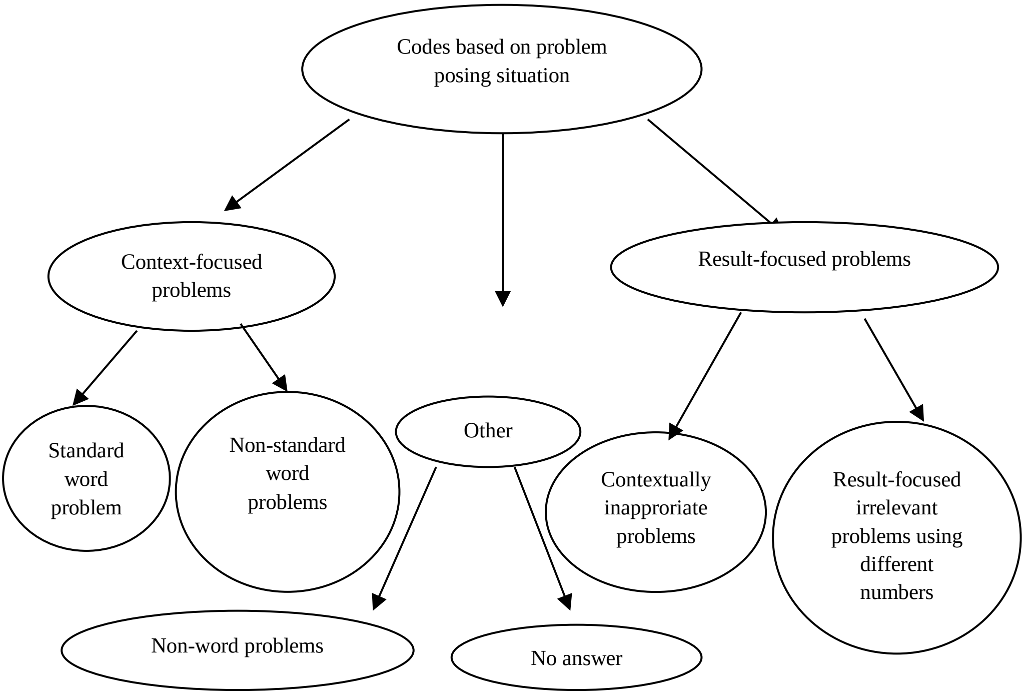


**Figure 1**: Framework for analyzing problem posing tendencies of participants

Raw data were coded and categories to capture relevant characteristics from the interview transcripts developed by the researcher. In the data display phase, the verbal information obtained from pre-service teachers was analyzed and collated in tables.In the conclusion drawing and verification phase, which was the third phase, the categories and sub-categories that emerged were interpreted and compared. These categories and sub-categories were developed by the researcher based on previous studies.In this study, posed problems were analyzed using a problem posing diagram that included categories and sub-categories. While developing that diagram, the opinions of two mathematics educators were considered. The diagram is shown in Figure 1.

## 2.4. Validity and Reliability

To confirm suitability of this problem posing content, the opinions of two mathematics educators having backgrounds related to problem types and problem posing were considered. The opinions indicated that the problem posing situation used in this study was suitable for pre-service teachers. In order to understand task-based interview questions' conformity, validity, and reliability, a pilot study was conducted with one pre-service teacher. As a result of the pilot study, as suggested by Goldin (2000) the questions were revised in order to reveal mathematical misconceptions and uncertainties as well asunexpectedsituations. In order to increase the reliability of the study, member checks and engagement techniques were used as suggested by Lincoln and Guba (1985). Furthermore, the researcher asked for the opinion and assessment of one colleague regarding the code list and research findings. In order to examine inter-rater reliability, another colleague independently classified the posed problems. The formula of Miles and Huberman (1994) was used to calculate inter-rater reliability and was determined to be 90%. In developing a framework for analyzing problem posing tasks, mathematics educators' suggestions were also considered. The pilot study also contributed the validity and reliability of this study.

## 3. Findings

**Table 1**. Problems posed by preservice teachers and their frequency and percentage for each problem posing item

| Answer codes | | | (PPMT)[c] (n = 48) | | (PPT)[d] (n = 61) | | Total | |
|---|---|---|---|---|---|---|---|---|
| | | | (f)[a] | (%)[b] | (f)[a] | (%)[b] | (PPMT)[c] (f)[a] (%)[b] | (PPT)[d] (f)[a] (%)[b] |
| Result-focused problems | Contextually inappropriate problems | 100:8 = 12 | 14 | 9.72 | 26 | 14.20 | 39 27.08 | 79 43.16 |
| | | 100:8 = 13 | 18 | 12.5 | 33 | 18.03 | | |
| | Result-focused irrelevant problems | 100:8 = 12 | 3 | 2.08 | 7 | 3.82 | | |
| | | 100:8 = 13 | 3 | 2.08 | 9 | 4.91 | | |
| | | 100:8 = 12.5 | 1 | 0.69 | 4 | 2.18 | | |

Table 1 continued

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Context-focused problems | Non-standard word problem | 100:8 = 12 | 25 | 17.36 | 16 | 8.74 | 88<br>61.11 | 70<br>38.25 |
| | | 100:8 = 13 | 18 | 12.5 | 3 | 1.63 | | |
| | Standard word problem | 100:8 = 12.5 | 45 | 31.25 | 51 | 27.86 | | |
| Other | No answer | 100:8 = 12 | 6 | 4.16 | 8 | 4.37 | 17<br>11.08 | 24<br>13.11 |
| | | 100:8 = 13 | 9 | 6.25 | 13 | 7.10 | | |
| | | 100:8 = 12.5 | 2 | 1.38 | 3 | 1.63 | | |
| | Non-word problem | 100:8 = 12 | - | - | 4 | 2.18 | 0<br>0 | 10<br>5.46 |
| | | 100:8 = 13 | - | - | 3 | 1.63 | | |
| | | 100:8 = 12.5 | - | - | 3 | 1.63 | | |
| Total | | | 144 | | 183 | | | |

[a]f = frequency, [b] % = percentage
[c]PPMT = pre-service mathematics teacher, [d]PPT = pre-service primary teacher

When asked to construct problems based on a structured problem posing situation, the participants posed *result-focused* and *context-focused* problems, and some of the posed problems were coded as *other*, which were not included in the other two types asssessed in Figure 1. Under RFPs, contextually inappropriate problems and result-focused irrelevant problems emerged. In CFPs, non-standard word problems and standard word problems were posed, some of the participants did not pose problems, and some of the posed problems were non-word problems. As shown in Table 1, pre-service primary teacher participants posed RFPs, whereas pre-service primary mathematics teachers mainly posed CFPs. Although no clear finding emerged for either group, non-word problems were predominantly posed by pre-service primary teachers only.

*Result-focused problems (RFPs)*

Looking at the problems posed by participants for structured problem posing, both groups had a tendency to pose contextually inappropriate problems and result-focused irrelevant problems at different rates.

*Contextually inappropriate problems*

Both pre-service primary teachers and preservice mathematics teachers posed contextually inappropriate problems based on 100:8 = 12 and 100:8 = 13. In both groups, posing problems that included 100:8 = 13 was problematic. In addition, pre-service primary teachers posed contextually inappropriate problems (14.20%, 100:8 = 12; 18.03%, 100:8 = 13) more than pre-service primary mathematics teachers (9.72%, 100:8 = 12; 12.5%, 100:8 = 13). Examples of the 100:8 = 12 problem posing situation as below:

Pre-service primary teacher participant Hasan posed the problem "Ahmet has 100 Turkish Liras. 8 people shared that money equally. After that sharing Ahmet bought chewing gum paying 0.5 Turkish Liras. How much moneydoes he has?" Participant Hasan posed a contextually inappropriate problem for 100:8 = 12. In this situation, participant focused on the result and only partially focused on the problem posing situation.

One of the pre-service mathematics teachers posed the problem "4 eggs among 100 eggs were broken. The remaining eggs will be delivered to 8 families. How many eggs will each family receive?"This participant's posed problem focused on the result and not the problem posing situation.

Example for 100:8 = 13. One of the pre-service mathematics teachers posed the problem "Melik has 100 Turkish Liras. He bought a notebook using 1/8 of his money and a rubber for 0.5 Turkish Liras. How much money did Melik spend?" In that problem, the participant focused on the result of the problem posing situation. He added 0.5 Turkish Liras, which is not included in the context of problem posing.

One of the pre-service primary teachers posed the following problem for 100:8 = 13: "Tuana bought 100 beads and he shared them with 8 people equally Tuana took one more bead; how many beads does Tuana now have?"The participant considered the result of the operation, which is a part of problem posing situation. The participant did not consider the entire problem posing situation.

*Result-focused irrelevant problems*

Under RFPs, a category of "result-focused irrelevant problems" emerged. Both pre-service primary and mathematics teachers posed result-focused irrelavant problems. They considered only results of the problem posing situation and not the context. This sitution emerged for all three scenarios. It was observed that the pre-service primary teachers posed more result-focused irrelevant problems (3.82%, 100:8 = 12; 4.91%, 100:8 = 13; 2.18%, 100:8 = 12.5) than pre-service mathematics teachers (2.08%, 100:8 = 12; 2.08%, 100:8 = 13; 0.69%, 100:8 = 12.5).

An example for 100:8 = 12 is discussed below:

One of the pre-service primary teachers posed the following irrelevant problem for 100:8 = 12: "36 apples had been shared among brothers equally. Each brother took 3 apples; how many brothers are there?"The participant did not consider the problem posing situation when that problem was posed. The participant only focused on the result of the posed problem. The numbers 36 and 3 were not included in the problem posing situation, but the participant considered these numbers anyway and came to the result of 12 by using them.

One pre-service primary school mathematics teacher, Yusuf, posed the problem "In a coop, there are 6 chickens. How many feet are there in that coop?"Participant Yusuf only considered the result of the problem posing situation. He did not consider the problem posing situation as a whole. He stated that at first he thought about the problemregardless of thesituation and did not consider the problem posing situation and thought to pose a problem that had a solution of 12. I focused on it.One of the pre-service primary teachers posed an irrelevant problem for 100:8=12.5, such as "A car can travel a distance of 200 km in 25 hours. That car was lost for half of the trip. How many hours did the car reach the middle of the road?" Although the result of the problem is 12.5, this proposed problem comprises different numbers that are not included in the problem posing situation.

One of the pre-service primary school teacher participants Fırat posed a problem for 100:8 = 12.5: "One person has 10 loaves of bread. If he buys 2.5 more loaves, how many loaves does he has? Participant Fırat only focused on the result of 100:8 = 12.5 and did not take into account the 100:8 = 12.5 problem posing situation. An example of the interview is shown below:

*I: Can you explain how you posed the problem?*

*Fırat: I considered mathematical rules and I benefited from the mathematical data given. I used fractions.*

*I:Do you think that the problem is appropriate for the given problem posing situation?*

*Fırat: I think it is appropriate for the given problem posing situation because I attempted to reach the result 12.*

*I: I see. Well what is the problem posing situation that is given to you here?*

*Fırat:Here it is a structured problem posing situation.*

*I: I mean which problem posing situation was given to you and you posed like that kind of problem?*

*Fırat: A result was given to me and I should attain that result.*

One of the pre-service primary school teachers posed an irrelevant problem for 100:8=13: "When 52 students are separated into 4 groups, how many students will be in every group?" Here, the participant only focused on the result and did not take into accounts the numbers in the problem posing situation.

*Context-focused problems (CFPs)*

In structured problem posing, participants posed problems by considering the context of problem posing. In that situation, participants posed non-standard and standard word problems. Pre-service primary and mathematics teachers posed both non-standard and standard word problems.

*Non-standard word problem*

Non-standard problems emerged in 100:8 = 12 and 100:8 = 13 scenarios. Both pre-service mathematics (13.88%, 100:8 = 12; 12.5%, 100:8 = 13) and primary school teachers (8.19%, 100:8 = 12; 1.63%, 100:8 = 13) posed non-standard word problems. It was observed that primary mathematics teachers posed non-standard word problems more often than pre-service primary teachers. There were some differences between posed problems for 100:8 = 12 and 100:8 = 13, where pre-service primary teachers posed non-standard word problems for 100:8 = 12 much more often than the 100:8 = 13 problem posing situation.

Examples of the posed non-standard word problems for 100:8 = 12 are described below. One pre-service mathmatics teacher posed the non-standard problem: "100 baloons will be shared between 8 friends. How many balloons does each friend take? The participant considered 100:8 = 12 and posed a non-standard word problem, which requires taking into account realistic considerations while solving the problem. One pre-service mathematics teacher posed the problem: "100 people work in a factory. These workers are divided into groups of 8 people. How many full groups are there?"

Examples of posed non-standard word problems for 100: 8 = 13 are discussed below:One pre-service primary teacher posed the problem for 100:8 = 13 was like"100 students will go on a picnic. Each vehicle can carry 8 students. How many vehicles are needed to carry the students?"The participant considered the problem posing situation and posed a problem that was different from a standard word problem. It requires consideration of reality.

The pre-service mathematics teacher participant Sinem posed the problem: "How many cars are needed when 100 people be carried in a car that can carry 8 people at a time?" Participant Sinem took into account the problem posing situation and posed a non-standard word problem. An interview with Sinem is shown below:

*I: I asked to you to pose a problem for 100:8 = 13, and you posed that kind of problem. Could you explain what you thought when posing the problem?*

*Sinem: Here, 100:8 = 12.5, but it is more than it. We should reach 13, so I wrote that 100 people will go somewhere and 8 people can ride in a car, and then asked how many cars are needed. It should be more than 12.5. Therefore, we need to divide 100 by 8 to arrive at 13. So I thought of a problem where the solution is 13.*

*Standard word problem*

Standard word problems emerged in the 100:8 = 12.5 scenario. Both pre-service mathematics (31.25%, 100:8 = 12.5) and primary (27.86%, 100:8 = 12.5) teachers posed standard word problems. The pre-service mathematics teachers posed standard word problems more than pre-service primary teachers. Standard word problem examples for the 100:8 = 12.5 scenario are described below:

Pre-service primary teacher Bahar posed the problem: "Ali has 100 slicesof chocolates. 8 friends would like to share them. How many pieces does everyone take equally?The interview with participant Bahar is shown below:

*I: Can you explain what you thought while posing that problem?*

*Bahar: I considered a real life situation while posing that problem. It seemed very logical for me. Children love them so much. It can behalf aslice of chocolate. The 12.5 concept can be represented easily. If I say ball or other items, it cannot be represented so easily.*

Participant Bahar chose aeasilydivisible reallife situation like chocolate.

Pre-service mathematics teacher Sevinç posed the following standard word problem: "A mother wants to share 100 Turkish Liras with her 8 children. How much money will be given to each of them?"Participant Sevinç posed a problem that is appropriate for 100:8 = 12.5. She mentioned that shetried to remember problems that you lectured in the lessons. First of all, I thought bread and then I considered money.

*Other*

In some cases, the participants did not provide any answer or the posed problems were non-standard word problems.

*No answer*

In three cases, no answer emerged. Both pre-service primary mathematics (4.16%, 100:8 = 12; 6.25%, 100:8 = 13; 1.38%, 100:8 = 12.5) and primary (4.37%, 100:8 = 12; 7.10%, 100:8 = 13; 1.63%, 100:8 = 12.5) teachers did not pose problems in some cases. Most of the situations where no answers were provided occurred for the 100:8 = 13 problem posing situation, and a few occurred for the 100:8 = 12.5 scenario. The percent of no answers was higher for pre-service primary school teachers more than pre-service mathematics teachers. An example of an interview conducted with participant İlyas is shown below:

*I: You did not pose any problem for 100:8 = 13.Why?*

*İlyas: I did not write any problem because I did not understnad that situation. I could pose a problem based on 100:8 = 12.5, but in this situation I could not think of any problem.*

Participant İlyas did not pose a problem regarding 100:8 = 13.

*Non-word problem*

In three cases, non-word problems were posed by pre-service primary teachers (2.18%, 100:8 = 12; 1.63%, 100:8 = 13; 1.63%, 100:8 = 12.5). Non-word problems were not posed by any of the pre-service mathematics teachers. Examples of non-word problems are shown below:

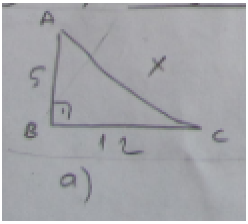


**Figure 2.** A sample response of non-word problem for 100:8=13 case

"That triangle is a right triangle. Find x."As seen from this example, it is not a word problem. Participant Mehmet did not pose a word problem.He only focused on the result to generate a problem.

## 4. Discussion

Solving and posing word problems are very important tasks for experiencing all aspects of word problems. Therefore, it is imperative to consider all contributions needed to generate a problem in terms of both the teacher (Barlow & Cates, 2006) and student (Leung, 1997; Nixon-Ponder, 1995; Rizvi, 2004; Silver, 1994; Stoyanova, 2003) in order to establish problem posing at the center of curicula. In schools, teachers are undoubtedly those whowill perform problem posing activities effectively. Hence, it is important for future teachers to be well trained and equipped with these skills.

This study investgated the word problem posing tendency of pre-service primary school and primary mathematics teachers in the context of a structured problem posing situation that had three different solutions. The data obtained from the study revealed that pre-service teachers posed problems considering both the result of the problem posed as well as the context. Result-focused problems are considered problematic by participants. Pre-service teachers considered the problem posing situation and posed non-standard and standard word problems focusing on the context of problem posing. Participants were able to pose non-standard problems, which can be solved by using arithmetical operations and taking into account real life knowledge. Differences were observed between the situations for posing non-standard word problems. Non-standard word problems were posed by participants for the 100:8 = 12 problem posing situation much more often than the 100:8 =

13 situation, which is appropriate for a division-with remainder problem type. This type of word problem requires mathematical thinking and reasoning (Yoshida et al., 1997) and has to be interpreted and evaluated as a function of the real world constraints of the problem setting (Chen et al., 2011). Among non-standard and standard word problems, standard word problems were posed most often by the participants. This observation is most likely due to previous experiences and knowledge for those types of problems. Pre-service mathematics teachers posed substantially more non-standard problems than pre-service primary teachers. In general, participants easily posed problems for 100:8 = 12.5 compared to the other situations. Therefore, it can be concluded that the problem posing situation affects the posing problem types of individuals.

Participants posed result-focused problems, such as contextually inappropriate problems and result-focused irrelevant problems. Contextually inappropriate problems were posed by participants much more often than result-focused irrelevant problems. In addition, pre-service mathematics teachers posed less result-focused problems than pre-service primary teachers. Another conclusion from this study is that pre-service primary mathematics teachers posed both non-standard and standard word problems more successfully than pre-service primary teachers and did not exhibit as many difficulties as pre-service primary teachers. This observation is mostly likely due to the previous experiences of the participants. In addition, pre-service mathematics teachers engage in mathematics much more frequently than pre-service primary teachers while preparing for university exams and during their teacher education programme. Quinn (1997) found out that the pre-service secondary mathematics teachers had more content knowledge than the pre-service elementary teachers did. That finding supports the result of that current study.

Among the problems posed by participants, some were not word problems, and in some cases the participants did not pose any problem. These findings are in agreement with those from the study by Chen et al. (2011). Moreover, no response was observed more often than non-word problems. Therefore, althoughthe number of teacher candidates who had issues with posing word problems was low, it is nevertheless necessary to improve lectures on this topic in teacher education programmes. Both pre-service primary and mathematics teachers had some difficulties in posing non-standard problems. It has been shown that pre-service teachers can have some difficulties in solving these types of problems (Kılıç, 2011; Verschaffel, De Corte & Borghart, 1997). Considering that problem posing can be used as an assessment (Lin, 2004) and as a diagnostic tool (Tichá & Hošpesová, 2009), this approach is a good way to understand pre-service teachers' mathematical knowledge as well as resolve and eliminate errors. Stoyanova (2003) indicated that problem posing activities that aim to develop students' understanding of mathematics depend on teachers' abilities to implement problem posing situations in mathematics classrooms.

Teachers' subject-matter knowledge and pedagogical content knowledge affects their teaching activities and students' mathematical learning processes and outcomes (Chen et al., 2011). Furthermore, the fact that problem posing may contribute to the development of pedegogical content knowledge of pre-service teachers (Tichá & Hošpesová,2009), it is imperative that these teachers are well educated in their teacher education programme. This will ensure that the mathematical and pedagogical content knowledge of pre-service teachers is enriched.

## 5. Recommendations

It is indicated that in order to improve the quality of education in primary schools in developing countries there is a need to place pedagogy and its training implications at the centre of teacher education reform (Hardman, Abd-Kadir & Tibuhinda, 2012). In order to remedy the difficulties that participants encountered in this study, the structure of inappropriate problems should be analyzed in more detail in order to investigate and understand the causes.

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