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Posing Problems with Photographs: Quality of Posed Problems by Pre-Service Teachers

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Abstract

Problem posing can create new problems based on given conditions or the reformulation of a given problem. Using descriptive-quantitative research, the pre-service mathematics teachers administered a problem-posing task with photographs. The task was given to all 20 pre-service Mathematics teachers of the Local College in Tangub City. The data gathered in this study were evaluated by considering; i.) the text of the problem, ii.) the problem's suitability to the mathematical concepts, iii.) the problem construction, and iv.) the possibility of solving the problem. Based on the findings, it can be concluded that the majority of the pre-service teachers can pose mathematical word problems which are clear, understandable, and solvable. They can also apply mathematical principles in posing word problems. However, most of them posed problems that were considered as exercises only. This confirms the researchers' arguments that pre-service teachers can pose very easy problems. Therefore, it is recommended that more time be spent in methods classes teaching problem kinds, problem-solving procedures, and problem posing. Furthermore, mathematics teaching should include challenging problems, letting the learners improve critical thinking skills, specifically in the problem-solving course. Thus, teachers' pedagogical content knowledge in mathematics teaching should include problem posing strategy.

Keywords: education, Mathematics, mathematical principles, problem-solving, word problems

Introduction

The nature of mathematical reasoning is understood to include problem posing as an important component (Kilpatrick 1987). It's been defined as the creation of new problems or the reformulation of an existing problem in order to research and solve a specific scenario (Ticha & Hopesova, 2009). A major purpose of mathematics education is to improve learners' problem-solving abilities, thus it must play a significant part in mathematical activities (Crespo, 2003). It is highlighted that mathematics students should be given opportunities to solve problems in the classroom (Stoyanova 2005; Singer et al. 2011; Cankoy 2014). It is thought that learning mathematics through posing problems in the classroom is a promising activity (Silver and Cai 1996; English 1998). For several years, researchers have discovered that problem posing considerably assists problem solving (Cankoy & Darbaz, 2010; Christou et al., 2005; Isk, 2011; Kilic, 2013).

Problem posing is a valuable mathematical exercise that can help people integrate their existing knowledge frameworks and gain mathematical knowledge. According to Van-Harpen and Presmeg (2013), students' mathematical knowledge and their ability to solve problems are connected. Not only for students and pre-service instructors, but also for teachers, posing difficulties is advantageous in many ways. One, it can be used to assess the impact of the curriculum on students' learning (Cai et al., 2012). Another advantage is that it may be used to investigate cognitive processes (Mestre, 2002), supporting students in improving their mathematics comprehension while also examining the nature of problems rather than just looking for solutions (Stoyanova, 2003). Furthermore, it encourages and promotes students' critical thinking skills (Nixon-Ponder, 1995) and denotes a complete understanding of an idea (Rizvi, 2004). As a result, problem-solving education based on problem posing can improve comprehension (Cankoy & Darbaz, 2010).

Allowing students to create their own questions can encourage them to think more creatively, enhance problem-solving skills, broaden their mathematical comprehension, and enrich and consolidate essential

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topics (English, 1996). Furthermore, problem-solving activities can provide valuable information about a child's understanding of mathematical concepts and techniques, as well as their attitudes toward problem-solving and mathematics in general (Brown and Walter 1993).

During their mathematics lessons with pre-service teachers, the researchers discovered that pre-service teachers have trouble posing word problems and can only submit simple and erroneous word problems.In order to increase their ability to pose problems in mathematics, it is necessary to have a comprehensive grasp of the developmental condition of the learners' thinking and reasoning.If teachers have information about what their pupils know and how they think, they will be able to create approaches to increase their students' achievement (Cai 2003).

Problem posing encourages pre-service teachers to actively learn and rethink mathematical objects and concepts without explicit teaching (Lavy & Shriki, 2010). Finally, instructors' actions can develop students' problem-solving behaviors, according to Lowrie (2002); hence, it is vital to educate teachers in this area during their initial training.Furthermore, because teachers' actions can nurture students' problem-posing actions (Lowrie, 2002), and because teachers must teach students how to practice problem posing, it is critical to recognize pre-service teachers' performance in problem posing as a problem-solving method so that they can be effectively educated during their years of training. Pre-service teachers should also be capable of introducing and correcting complex mathematical problems (Lavy & Shriki, 2010; Ticha & Hopesova, 2009; Toluk-Ucar, 2009).According to several research, pre-service teachers frequently struggle with problem-solving activities (Korkmaz & Gur, 2006; Luo, 2009; Toluk-Ucar, 2009).The knowledge of a teacher has a significant impact on student achievement (Ball et al., 2008; Hill, Rowan & Ball, 2005; Kulm, 2008).To put it another way, teachers who lack the necessary skill and experience in the subjects they are supposed to teach will find it difficult to do so.

Limin, Van Dooren, and Verschaffel (2013) proposed that there is a strong association between problem posing and problem solving, which is utilized in this research. The notion is specifically employed to identify

whether pre-service teachers have a good performance in problem solving by analyzing their problem posing performance. Furthermore, the pre-service teachers' posed difficulties were evaluated using Katranci and Sengul (2014)'s evaluation technique. The text of the problem, the problem suitability to the mathematical concepts, the problem construction, and the possibility of solving the problem are all factors to consider.

The researchers discovered that pre-service instructors struggle with problem solving, particularly word problems. The purpose of this study is to assess the quality of pre-service teachers' posed problems using images in order to identify specific areas of concern in word problem solution. It also looked at pre-service teachers' problem-solving abilities in order to support instructors' pedagogical topic knowledge in the teaching of mathematical problem-solving procedures. No studies have used photos to assess the quality of pre-service instructors' posed issues, to the best of the researchers' knowledge. Furthermore, there have been no research on problem posing in the Philippines. Hence, this study is constrained in order to contribute to the filling of these gaps in the literature.

Materials and Methods

This is a quantitative study that aimed to disclose the outcomes of a particular situation. The evaluation of the posed problems was based on four criteria: the text of the problem, the problem suitability to the mathematical concepts, the problem construction, and the possibility of solving the problem, in order to understand pre-service teachers' thinking and reasoning on word problems. This method of evaluation was developed by Katranci and Sengul (2014).

The study included all 20 pre-service mathematics teachers who are already in the field for teaching experience. From these participants, 9 are female and 11 are male; all were 19 - 22 years old. The study considered the population of the mathematics pre-service teachers of the Local College in Tangub City. Hence, no sampling technique was applied.

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It is expected that all participants have fundamental problem-solving skills and can apply such skills to create issues. To maintain anonymity, all participants were assigned the codes R1, R2, R3..., R20.

A questionnaire with five photographs of real-life scenes where a possible mathematical problem can be formulated was used. These are photographs like: a garden, a man looking at the plane, two persons who are painting, a ship, and stacks of cups.

The researchers sought permission from the College President to allow them to conduct the research study. Then, a permission from the research office ethics committee was sought. Before the collection of data, the pre-service teachers were given consent form and were guaranteed that all the data gathered were treated with extreme confidentiality and were utilized for academic purposes only. The data of this study were collected by requiring all participants to pose challenges using the five photos provided. The questionnaire was prepared by the researchers and administered to pre-service teachers.

In order to provide a thorough picture of the searched problem, the researchers confirmed the data and results of the study by variation, participant confirmation, and colleague confirmation (Yldrm & Simsek, 2008). In this regard, in addition to the researchers, two professionals in the field of teaching mathematics analyzed the data received from the participants. Text of the problem, the problem suitability to the mathematical concepts, the problem construction, and the possibility of solving the problem were used as a guideline by Katranci and Sengul (2014). The researchers and two specialists in the field of mathematics education analyzed each problem separately, and the results were compared. A settlement was reached after the disagreements were explored. Furthermore, the study was validated by a colleague's confirmation.

Results and Discussion

This section presents the results of the evaluation of the pre-service teachers posed problems from photographs based on the criteria considered. Table 1-5 presents the quality of posed problems while table 6 and 7 shows the analysis of the responses on the problems encountered during the posing activity and the perception on posing problems respectively.

Table 1. Garden Problem.

Evaluation Criteria		f	%
Text of the Problem	The problem is neither clear nor understandable.	1	5
	The problem is fairly clear and understandable.	2	10
	The problem is clear and understandable.	17	85
Problem Suitability to the Mathematical Concepts	The problem does not fit to the principles of mathematics.		
	The problem quite fits to the principles of mathematics.		
	The problem suits to the principles of mathematics.	20	100
Problem Construction	Exercise	15	75
	Simple ordinary problem	3	15
	Ordinary problem	2	10
Possibility of Solving the Problem	The problem is impossible to solve.	1	5
	The problem is possible to be solved but has errors.	1	5
	The problem can be solved.	18	90

Table 1 reveals that the text of the problem 17 (85 %) of the problems posed is clear and intelligible. It is worth noting that all 20 (100%) problems are solvable using mathematical methods. It appears

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that 15 (75%) of the problems posed are considered as exercise. The majority of the problems posed (90%) by pre-service mathematics teachers about the task of posing problems on garden photographs are solvable. The results reveal that the pre-service teachers can pose problems but are considered very easy.

Table 2. Painter Problem.

Evaluation Criteria		f	%
Text of the Problem	The problem is neither clear nor understandable.		
	The problem is fairly clear and understandable.	5	25
	The problem is clear and understandable.	15	75
Problem Suitability to the Mathematical Concepts	The problem does not fit to the principles of mathematics.	3	15
	The problem quite fits to the principles of mathematics.	4	20
	The problem suits to the principles of mathematics.	13	65
Problem Construction	Exercise	16	80
	Simple ordinary problem	4	20
	Ordinary problem		
Possibility of Solving the Problem	The problem is impossible to solve.	8	40
	The problem is possible to be solved but has errors.	1	5
	The problem can be solved.	11	55

As shown in table 2, 15 (75%) of the problems posed are clear and comprehensible. On the other hand, 13(65%) of the created problems from the photograph of painters are appropriate to mathematical principles. It is also seen in the table that an impressive 16(80%) of the problems are considered an exercise. However, only 11 (55%) of the problems are solvable, while 8 (40 %) are impossible to solve. This indicates that almost half of the problems posed on the painter's portrait

were missing critical information needed to answer the problem. The results signify that not all of the pre-service teachers can pose solvable problems. Moreover, they can only pose problem that are very easy.

Table 3. The Ship Problem.

Evaluation Criteria		f	%
Text of the Problem	The problem is neither clear nor understandable.	1	5
	The problem is fairly clear and understandable.	7	35
	The problem is clear and understandable.	12	60
Problem Suitability to the Mathematical Concepts	The problem does not fit to the principles of mathematics.		
	The problem quite fits to the principles of mathematics.	1	5
	The problem suits to the principles of mathematics.	19	95
Problem Construction	Exercise	13	65
	Simple ordinary problem	5	25
	Ordinary problem	2	10
Possibility of Solving the Problem	The problem is impossible to solve.	3	15
	The problem is possible to be solved but has errors.	1	5
	The problem can be solved.	16	80

The assessment of the posed problems on the photograph of a ship is shown in Table 3. The table shows that the bulk of the posed problems, or 12 (60 %), are plain and intelligible. A significant 19 (95%) of the stated problems, on the other hand, are amenable to mathematical principles. This suggests that the majority of pre-service teachers could pose problems based on mathematical principles. However, 13 (65%) of the problems proposed are only exercises. This means that the problems

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are straightforward. Furthermore, 16(80%) of the problems generated are solvable. The results show that pre-service teachers can pose problems yet very easy.

Table 4. The Cups Problem.

Evaluation Criteria		**f**	**%**
Text of the Problem	The problem is neither clear nor understandable.	1	5
	The problem is fairly clear and understandable.	8	40
	The problem is clear and understandable.	11	55
Problem Suitability to the Mathematical Concepts	The problem does not fit to the principles of mathematics.	3	15
	The problem quite fits to the principles of mathematics.	2	10
	The problem suits to the principles of mathematics.	15	75
Problem Construction	Exercise	13	65
	Simple ordinary problem	4	20
	Ordinary problem	3	15
Possibility of Solving the Problem	The problem is impossible to solve.		
	The problem is possible to be solved but has errors.	2	10
	The problem can be solved.	18	90

Table 4 shows the outcome of the pre-service teachers' evaluated posed issues on a photograph of cups. As revealed, 11(55%) of the text in the posed problems are clear and understandable. While 15(75%) of the problems conforms to the principles in mathematics. A good number of the problems that is 13(65%) are considered to be an exercise but 7(35%) are better problems since these are simple ordinary and ordinary problems. As to the solvability of the problems, 18(90%) are solvable.

The results imply that the pre-service teachers can pose problems yet considered easy problems.

Table 5. Airplane Problem.

Evaluation Criteria		f	%
Text of the Problem	The problem is neither clear nor understandable.		
	The problem is fairly clear and understandable.	8	40
	The problem is clear and understandable.	12	60
Problem Suitability to the Mathematical Concepts	The problem does not fit to the principles of mathematics.	1	5
	The problem quite fits to the principles of mathematics.	4	20
	The problem suits to the principles of mathematics.	15	75
Problem Construction	Exercise	10	50
	Simple ordinary problem	9	45
	Ordinary problem	1	5
Possibility of Solving the Problem	The problem is impossible to solve.	2	10
	The problem is possible to be solved but has errors.	3	15
	The problem can be solved.	15	75

Table 5 presents the product of the evaluation of the posed problems on the photograph of an airplane. As can be seen from the table above, 12 (60%) of the problems are clear and understandable, while 15 (75%) are applicable to mathematical principles. Moreover, half of the problems formulated are exercise and 15(75%) are solvable. The results show that pre-service teachers can pose solvable problems. They can also pose simple ordinary problems.

In general, more than half of the Pre-Service teachers' problems were presented in a straightforward and intelligible manner. This contradicts the findings of Luo (2009), who discovered that when given

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certain symbolic expressions, pre-service instructors were unable to offer acceptable word problems. At least 65 percent of pre-service instructors generated problems that were suited with mathematical concepts in order to ensure that the problem was compatible with them.

Pre-Service Teachers struggled to generate a conceptually correct representation of statements provided to them, according to Toluk-Ucar (2009) findings. In addition, half of the posed problems for Pre-Service Teachers are exercise-type problems, which means they are less difficult to solve than the other half. Finally, most of the posed problems are solvable in terms of their solvability. This indicates that the problems that have been generated are well-thought-out. Because they were able to design solvable questions, this also implies that the pre-service teachers have sufficient problem-solving knowledge.

Conclusions and Recommendations

Based on the findings, it can be concluded that majority of the pre-service teachers can pose mathematical word problems which are clear, understandable and solvable. They can also apply mathematical principles in posing a mathematical problem. However, most of them posed problems which were considered as exercises only. This confirms the researchers' argument that pre-service teachers can only pose very easy problems. Applying the concept of Limin, Van Dooren and Verschaffel (2013) that a strong relationship between problem posing and problem solving exists, it can further be concluded that pre-service teachers will be able to solve word problems which are considered easy.

The result of the study can contribute to improving pre-service teachers' performance in problem solving by crafting learning materials in Mathematics that include problem posing in assessing students' performance and in the delivery of instruction.

It can be recommended that more time should be spent in methods classes teaching problem kinds, problem-solving procedures, and problem posing. Mathematics teaching should include difficult and challenging problems, which could let the learners improve critical

thinking skill specifically in the problem solving course. Thus, teacher's pedagogical content knowledge in the actual teaching of mathematics should include problem posing strategy. Specifically, problem posing must be included as an assessment tool as well as a teaching strategy in a problem solving course for the third year BSEd Mathematics students.

Another recommendation for future studies is that a study similar to this study could be done with students from senior high school to evaluate their problem posing ability that requires their knowledge on problem-solving strategies.

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Literature Cited

Cai, J., Moyer, J. C., Wang, N., Hwang, S., Nie, B., & Garber, T. (2012). Mathematical problem posing as a measure of curricular effect on students' learning. Educational Studies in Mathematics, 83(1), 57–69.

Cankoy, O., & Darbaz, S. (2010). Effect of a problem posing based problem solving instruction on understanding problem. Hacettepe University Education Faculty Journal,38, 11–24.

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Christou, C., Mousoulides, N., Pittalis M., Pitta-Pantazi, D., & Sriraman, B. (2005). An empirical taxonomy of problem posing process. ZDM Mathematics Education, 37(3), 149–158.

Contreras, J. (2007). Unraveling the mystery of the origin of mathematical problems: Using a problem-posing framework with prospective mathematics teachers. The Mathematics Educator, 17(2), 15–23.

Crespo, S., & Sinclair, N. (2008). What makes a problem mathematically interesting? Inviting prospective teachers to pose better problems. Journal of Mathematics Teacher Education, 11(5), 395–415.

Fraenkel, J. R., & Wallen, N. E. (2005). How to design and evaluate research in education. New York, NY: Mc Graw Hill.

Işık, C. (2011). Conceptual analysis of multiplication and division in fractions posed by pre-service elementary mathematics teachers. Hacettepe University Journal of Education Faculty, 41, 231–243.

Johnson, B., Onwuegbuzie A.J., & Turner, L.A. (2007). Toward a definition f mixed methods research. *Journal of Mixed Methods Research.* 112-133.

Kar, T. (2015). Analysis of problems posed by sixth-grade middle school students for the addition of fractions in terms of semantic structures. International Journal of Mathematical Education in Science and Technology, 46(3), 1-16.

Katranci, Y., & Sengul, S. (2014). The Analysis of the problems Posed by Prospective Mathematics Teachers about 'Ratio and Proportion' Subject. Procedia Social and Behavioral Sciences, 174(2015) 1364-1370.

Kılıç, Ç. (2013). Pre-service primary teachers' free problem posing performances in the context of fractions: An example from Turkey. The Asia Pacific Education Researcher, 22(4), 677–686.

Korkmaz, E., & Gür, H. (2006). Öğretmen adaylarının problem kurma becerilerinin belirlenmesi [Determining of prospective teachers' problem posing skills]. Balıkesir Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 8(1), 64–74.

Kulm, G. (2008). Teachers' mathematics knowledge. School Science and Mathematics, 108, 2-3.

Lavy, I., & Shriki, A. (2010). Engaging in problem posing activities in a dynamic geometry setting and the development of prospective teachers' mathematical knowledge. Journal of Mathematical Behavior, 29, 11–24.

Limin, C., Van Dooren W., & Verschaffel, L. (2013). The Relationship between Students' Problem Posing and Problem Solving Abilities and Beliefs: A Small-Scale Study with Chinese Elementary School Children. Front Educ China.147-161.

Luo, F. (2009). Evaluating the effectiveness and insights of pre-service elementary teachers' abilities to construct word problems for fraction multiplication. Journal of Mathematics Education, 2(1), 83–98.

McAllister, C. J., & Beaver, C. (2012). Identification of error types in preservice teachers' attempts to create fraction story problems for specified operations. School Science and Mathematics, 112(2), 88-98.

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Stoyanova, E. (2003). Extending students' understanding of mathematics via problem posing. The Australian Mathematics Teacher, 59(2), 32–40.

Tichá, M., & Hošpesová, A. (2012). Developing teachers' subject didactic competence through problem posing. Educational Studies in Mathematics, 83(1), 133–143.

Toluk-Uçar, Z. (2009). Developing pre-service teachers understanding of fractions through problem posing. Teaching and Teacher Education, 25(1), 166–175.

Van Harpen, X. Y., & Presmeg, N. C. (2013). An investigation of relationships between students' mathematical problem-posing abilities and their mathematical content knowledge. Educational Studies in Mathematics, 83(1), 117–132.