

The Creative Thinking Process of Prospective Teachers in Developing Assignments

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The accomplishment of developing assignments is a critical aspect for prospective teachers in the teaching and learning process. The prospective students' competence in developing assignments requires further investigation. The creative thinking process of prospective teacher students in developing different tasks. This difference is what generates creativity in developing tasks. The research conducted by (Catherine, 2009) showed several innovative techniques for generating new problems in mathematics. However, it was not sufficient to develop the given assignments. This study aimed to analyze the creative thinking process of prospective teachers in developing mathematics assignment. Twenty-five (25) prospective teachers conducting teaching practice became the subjects of this study. The research findings showed that creative thinking process of prospective teachers in developing assignments was creative and innovative in developing new assignments.

Keywords: thinking process, creative, assignment development

INTRODUCTION

Professionals state that the increasingly rapid development of the digital world makes new professions require creative skills. Therefore, to face a more modern future, every individual needs to develop various kinds of skills. Among the many skills that must be possessed, creative thinking skills and advanced structure of problem solving are priorities in the 21st Century (Liljedahl & Trigo, 2016).

Creative thinking skills are one type of skill that has received widespread attention from cognitive psychologists and is the goal of education in every country (Gorbarch et al, 2003). In line with this opinion, (Aldig, E. & Arseven, 2017) argue that the changing world increasingly requires individuals who have adaptability skills, so that every country needs individuals who are able to use information correctly,

produce information, and have creative thinking skills. Creative thinking skills are a supporting factor for each individual's creativity (Albert, 2016).

The focus of Mathematics Education these days is to develop creative thinking where the students are given the freedom to try to give new answers themselves (Lee, K., Lee, E., & Park, 2016). It means that the teaching and learning process avoids using the traditional teaching model, which leads to convergent thinking. However, in the process of teaching and learning, most teachers give closed assignments to the students. Mathematics assignment reflects the materials studied by the students (Ham, 2021), so the mathematics teaching and learning process is influenced by the assignments developed by the teachers.

The teaching and learning process at school can be optimized with intensive communication among teachers and students (Anthony et al., 2019; Kashefi et al., 2012). (Enciso, 2017) in their research stated that as the students spend a lot of time at school, teachers aim at developing students' creativity competence during the teaching and learning process. Students' creativity can develop through resolving the questions from teachers (Chikiwa, C & Schafer, 2018). Teachers' questions can be arranged in the form of an assignment designed before the teaching and learning process. The given assignments have to be continuously developed so that the students can maximize their creativity in the thinking process. The resulted assignment development should be better in quality compared to those found on the internet. The students' comprehension who works on the developed assignments is more comprehensive than those who work on the assignments adopted from the internet or books only. Developing assignments is one of the practical activities for teacher candidates to understand the role of mathematics assignments in the process of teaching and learning Mathematics (Lee et al., 2016).

Mathematics assignments are closely related to the learning process. Making assignments is an effective activity for prospective teachers to understand the role of math assignments in the mathematics learning process (Lee et al., 2016). Mathematics assignments reflect what content students will learn and what is required to do mathematics (Ham, 2021). Tasks that have been developed by prospective teacher students can also encourage students to be able to construct their knowledge independently, including honing critical thinking skills. (Cargas, S., Williams, S., & Rosenberg, 2017) stated that developing performance tasks regularly in a problem-based learning environment can contribute to students' critical thinking skills. Critical thinking allows students to think about how they use their discipline of mathematical skills (that is, they think about their thinking methods) (Fang, H., Angie, H., & Ricci, F. A., 2016). This shows that in the process of learning mathematics is influenced by the tasks that are designed or developed. Making assignments is one of the effective activities for students in understanding the role of mathematics assignments in the mathematics learning process (Lee et al., 2016).

Each teacher may construct different assignments since the process is affected by their creative thinking process. The creative thinking process of prospective teachers represents their process of remembering their previously acquired knowledge. The objective of this research is similar to research conducted before (Riyadi et al., 2021; Samo, 2021). We aimed to obtain information, process, and conclude the process of prospective teachers in developing assignments. A good creative thinking process enhances students' learning achievement. Based on the gap between expectation and implementation of the teaching and learning process, the creative thinking process of prospective teachers in developing mathematics assignments needs further investigation.

(Khodijah, 2006) pronounced that thinking is the linkage of previously attained knowledge. Meanwhile, (Maulidya, 2018), in her research, summarized that thinking is an activity of using a symbol or a concept of changing phenomenon and thinking object which generalizes ideas. During the thinking process, several activities are involved, such as retention, processing, and calling out of the information that have been stored.

Mathematics assignments can be structured from several questions. The development of questions in this research is defined as an effort to produce or obtain new questions based on the previously known questions, as explained by the research conducted by (Hen & Sharabi-Nov, 2014; Lee et al., 2016). (McCarthy et al, 2016) classified questions into four categories, namely (1) probing and follow-up, (2) leading questions, (3) check-listing, and (4) student-specific questioning. Probing questions aim to collect deeper information and dig into the thinking. This kind of question is suitable for investigative interview

patterns. The leading question is the question aiming at finding out information from someone who often avoids direct answers. Check-listing is a questioning pattern that provides a checklist for temporary questions, while student-specific questioning is a question that is explicitly given to the students.

According to previous research, one of the factors which can improve the teaching and learning process is the teacher’s ability to formulate a question. The questions asked by the teachers can increase the students’ learning quality and become a self-reflection of the teaching and learning process. Therefore, if the questions are not well-presented, they will damage the teaching and learning process (McCarthy et al, 2016). In line with the statement of (Bülent Döş et al, 2016), questions can be used as a critical assessment tool. It signifies that appropriate questioning can be used as a measurement in the teaching and learning process. (Tanner KD, 2017) in his research stated that the accuracy of question organization affects students’ academic achievement increase and metacognitive development.

METHOD

The objective of this research was to find out the creative thinking process of prospective teachers in developing mathematics assignments. The given assignment was arranged into several questions. The proposed questions should have met the question structure in the cognitive aspect. The questions were application questions that specifically involved the Pythagorean theorem.

The research design was descriptive qualitative research. (Nawawi H, 2012) stated that the descriptive method is a procedure for solving problems by overviewing a phenomenon or research object. The research subject was 25 teacher candidates in Malang City who were conducting teaching practice. A test instrument was used to observe how the creative thinking process of teacher candidates in developing assignments. The participants were given two questions and asked to make questions from the two questions items. The participants could develop the questions according to their creativity. (Catherine, 2009) explained that innovation techniques that can be used in developing problems are addition, replacement, point-of-view shifting, transformation, and plot recycling. In this research, innovation techniques that became the benchmark in developing assignments were addition, replacement, point-of-view shifting, transformation, plot recycling, and innovations from the research findings.

RESULT

Based on the analysis results of the test instrument for developing assignments given to the subject and interview results, some prospective teachers had different thinking patterns. Some of their thinking patterns were addition, replacement, point-of-view shifting, transformation, recycling, and new innovation formed that combined several innovations into one.

Creative Thinking Process of Addition

The prospective teachers’ creative thinking process in developing assignments was by adding new problems or adding new variables but still using the provided basic problem. Students’ creativity in developing assignments using this pattern is presented in Table 1.

TABLE 1
PARTICIPANTS’ CREATIVE THINKING PROCESS OF ADDITION

Basic problem	Development result
<i>“A triangle has respective side measures of 10 cm, 24 cm, and 26 cm. Is the triangle a right triangle?”</i>	<i>“A triangle has respective side measures of A=10 cm, B=24 cm, and C=26 cm. Is triangle ABC a right triangle, and can you find the area of triangle ABC?”</i>

Based on the interview, the students added symbols for each triangle side and added a new problem. The basis of problem development carried out by the prospective teachers was examining whether or not the formed triangle was a right triangle by using Pythagoras' theorem. When it was found that the formed triangle was a right triangle, they added the problem of finding out the area of the triangle. In the thinking process, the participants might add the question of finding out the perimeter of the triangle, but they chose to add the question of finding out the area of the triangle because they thought that it was essential to strengthen the students' conceptual understanding of the triangle area.

Creative Thinking Process of Replacement

This innovative technique was widely used by prospective teachers in developing questions. Approximately 80% of them had a creative thinking process of replacing numbers, names, or quantities. It means that the participants often use replacement innovation techniques in developing questions. An example of a prospective teacher's result in developing questions can be seen in Table 2.

TABLE 2
PARTICIPANTS' CREATIVE THINKING PROCESS OF REPLACEMENT ON THE FIRST QUESTION

Basic question	Development result
A triangle has respective side measures of 10 cm, 24 cm, and 26 cm. Is the triangle a right triangle?	It was known that a triangle has respective side measures of 9 cm, 25 cm, and 16 cm. Please, decide if the triangle is a right triangle!

The creative thinking process carried out by the participants was by replacing the numbers without changing the given basic question. According to the interview result, it was obtained that the prospective teachers were not accustomed to questions using triple Pythagoras, so they found it hard when they wanted to find out the numbers forming triple Pythagoras. The participants' creative thinking process of replacement was also observed in question number two, as shown in Table 3.

TABLE 3
PARTICIPANTS' CREATIVE THINKING PROCESS OF REPLACEMENT ON THE SECOND QUESTION

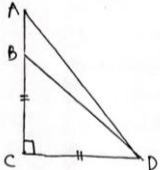
Basic question	Development result
Pak Adi owns rectangular land with an area of 300 m ² . The land is divided into two triangles. The first triangle will be filled with goats, while the second triangle will be filled with cattle. If Pak Adi wants to build a guardrail so that the cattle and the goats don't get mixed up, how long is the guardrail needed?	Pak Andi owns rectangular land with an area of 400 m ² . The land is divided into two triangles. Each rectangle will be filled with livestock and built with a guardrail. How long is the guardrail needed?

Based on Table 3, the creative thinking process of the prospective teachers was replacing the name and number, but they did not replace the object or subject in the basic question. The result of the interview showed that they replaced names and numbers to help students finish the descriptive question. This showed that finishing the descriptive question was considered as difficult for some participants.

Creative Thinking Process of Point-of-View Shifting

In the creative thinking process of point-of-view shifting, the prospective teachers changed the problem but still took the same part. The result of the question development is shown in Table 4.

TABLE 4
STUDENTS' CREATIVE THINKING PROCESS OF POINT-OF-VIEW SHIFTING

Basic question	Development result
A triangle has respective side measures of 10 cm, 24 cm, and 26 cm. Is the triangle a right triangle?	<p>Observe the following picture!</p>  <p>It is known that CD is 10 cm long and AD is 26 cm long. The length of AB is ...</p>

The participants' creative thinking process of point-of-view shifting was shown by changing the question into the form of a picture and the problem. The prospective teachers still used the same number as the basic question as they thought that if the problem was changed and if they added a picture, it would help the students to solve the problem. The participants tended to prefer using the same number and developing the question only by changing the problem without changing the question structure.

Creative Thinking Process of Transformation

The creative thinking process of transformation was completed by contextualizing the problem so that it became more relevant. It means that the participants developed the question by transforming and correlating it to the factual situation. One of the participants' representation forms was transforming the basic question into a descriptive question. The result of the prospective teachers' question development can be seen in Table 5.

TABLE 5
THE CREATIVE THINKING PROCESS OF THE PARTICIPANTS

Basic question	Development result
A triangle has respective side measures of 10 cm, 24 cm, and 26 cm. Is the triangle a right triangle?	If someone runs in the west direction as far as 20 m, then he runs in the south direction as far as 35 m. What is the distance between the last spot he stands on and the initial spot?

In this creative thinking activity of transformation, the prospective teachers were transforming the basic question into a more relevant descriptive question. The prospective teachers were required to be able to create a story according to the daily activities to develop the question. Their steps were deciding the topic of the given question and correlating the theme with daily activities. After determining the main idea, the next step was to arrange sentences to be comprehensible.

Other Creative Thinking Processes

Another creative thinking process was the result of the classification creative thinking, which was not included in the innovation techniques discussed before. The question developed by the participants was considered creative since the highlight was not only the question transformation but also the idea of how the students could solve the developed question. The innovation technique done by the prospective teachers was usually in the form of a picture or open-ended question designed to maintain the students' interest in solving the problems and train their thinking process. This type of question made students become more excited in the teaching and learning process. The example of assignment development with creative thinking can be seen in Table 6.

TABLE 6
PARTICIPANTS' CREATIVE THINKING PROCESS

Basic question	Development result
A triangle has respective side measures of 10 cm, 24 cm, and 26 cm. Is the triangle a right triangle?	Make a right triangle by determining the wanted side measures!

Based on Table 6, it can be seen that participants understood the objective of the basic question, which was imposing Pythagoras' concept. Therefore, the creative thinking process of assignment development result can be seen as the prospective teachers' open-ended questions so that it provides the students the opportunity to gain knowledge or experience by discovering, recognizing, and solving problems using various techniques.

DISCUSSION

These research findings showed the presence of other thinking processes which were not included in the innovative techniques in producing new problems in mathematics, according to (Catherine, 2009). In the creative thinking process of addition, students tend to add new variables. It was in line with a study conducted by (T. Siswono, 2008b) that individual in the low competence group tends to make problems more easily by adding symbols or variables. Replacement in the creative thinking process is often done by students who are not accustomed to developing assignments. (T. Y. E. Siswono, 2010) explained that individuals who are creative in constructing problems are accustomed to solving mathematics problems.

Point-of-view shifting in the creative thinking process was carried out by changing the problems but still taking a small part of the basic problems. This finding showed that prospective students start to acquire better creativity. (Mann, 2005) discovered that mathematical creativity is described as the process of making problem modifications. After that, the transformation in the creative thinking process was carried out by contextualizing problems so that it facilitated students in solving the provided problems. It is in line with (Barak, M., Watted, A., & Hossam, 2016), who explained that students' learning motivation in solving problems is based on contextual problems.

In addition, this study also identified another creative thinking process where the prospective teachers developed assignments by constructing open-ended problems. (Becker, J. P. & Shimada, 2005) stated that open-ended questions given to students are able to shape students' critical and creative thinking. The most crucial point in this research was that the creativity shaped by the creative thinking process of the prospective teacher in developing assignments influences the teaching and learning process positively.

CONCLUSION

The creative thinking processes of prospective teachers in developing assignments were different from one another. This difference leads to creativity in developing assignments. Several innovation techniques which can be done are addition, replacement, point-of-view shifting, transformation, and others. Prior knowledge acquired by prospective teachers is the main factor affecting their innovative techniques in developing assignments. In this discussion, this research analyzed the creative thinking process of prospective teachers in changing the basic problems by making creative innovations. The difficulties faced by the teacher candidate in the creative thinking process were the material concept understanding and their prior knowledge.

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