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The creative thinking process of teachers in designing mathematical tasks

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Abstract. Students have different backgrounds and abilities. Because of that, teachers must be smart in choosing and giving math tasks to their students. The aim of this study is to reveal the process of creative thinking of teachers in designing mathematical tasks. A participant in this study was Bibah (it is a fake name) based on the functional position of the teacher (focusing on the baginner teacher) elementary school teachers in the Pangkep district of South Sulawesi. This study uses a qualitative approach, with data collection methods using task-based interviews. From the results obtained, we find the biblical thinking process following the sequence of the synthesis stage of ideas, building ideas, planning the implementation of ideas, synthesizing ideas, planning the implementation of ideas and application of ideas.

1. Introduction

The design of mathematical tasks is important things in mathematics learning [1,2,3]. The tasks that are involving students can provide opportunities and an overall learning experience [4]. Assigned tasks may limit or expand students views in learning [5]. The results that were obtained by students will be different depending on the type of task they get [6]. Because of that the teachers should be good enough at selecting and adjusting the tasks assignment that fits with the learning objectives, targeting mathematical content and student ability [7]. Stein, M. K., & Lane, S. conducted research on teachers who succeeded in selecting and preparing the types of mathematical tasks and that is increasing student learning outcomes [8]. The characteristics of the mathematical task are: 1) a part of the real world problem, 2) Allows to have multiple solutions, 3) Provides students to have the opportunities to develop many solutions and strategies, 4) involves various representations, 5) Students proposing mathematical ideas, 6) Expecting students to communicate their reasoning, and 7) Reflecting as a continuous process [9]. Based on this opinion, designing the tasks in this research contains several specific traits such as allowing multiple solutions and answers, using the concept and situation of the context that is familiar with the students, it is accepted by students with various degrees of ability, allows to respond at the level think creatively about the task.

Teachers who have knowledge of math will be better prepared for learning. The knowledge of mathematic teachers affect their effectiveness in facilitating learning [10]. Students have different backgrounds and abilities, so students have different levels of creative thinking [11]. In order to encourage students in thinking and reasoning mathematical ideas, it is important for teachers to focus on creative tasks. In order to encourage students in thinking and reasoning mathematical ideas, it is important for teachers to focus on creative tasks [12, 13]. Creative thinking is the ability to uncover the

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new relations, see things from a new point of view, and form new combinations of two or more concepts that already mastered before [14]. A further explanation of creative thinking is the ability to develop or discover new, aesthetic, and constructive ideas or ideas relating to views and concepts, and emphasizes intuitive and rational thinking, especially in the use of information and even to bring or explain with the original perspective of the thinker [15]. The novelty and originality of creative thinking may be the characteristic most directly related to creativity [16]. The stages of creative thinking starts from synthesizing ideas, building ideas and applying ideas [17]. Someone needs to understand the problem (find goals, facts and find problems), generate ideas and plan actions (find solutions, find support) in the creative thinking stage [18]. That creative thinking refers to the ability to synthesizing ideas, building an ideas, planning, implementing an ideas and application an ideas [19]. Based on the explanation, the stages in the teacher's creative thinking process are shown in table 1.

Table. 1. Indicator of creative thinking process

Characteristics of creative thinking	Indicators that are the researcher wants to know
Synthesizing an ideas	Brings up ideas that are derived from various sources, early knowledge of students, and the actual things that students have experienced, as a result of the synthesis of previous ideas.
Building an ideas	Choosing the ideas that derived from various sources, early knowledge of students, and the actual moment that students have experienced.
planning applying ideas	Choosing the ideas that obtained from various sources, early knowledge of students, and the actual things that students have experienced.
Application the ideas	Implements or uses or application the ideas that are designed to create mathematical tasks.

The stages of creative thinking in table 1 refer to developed theory [19], that reveals the creative thinking process of teachers include (synthesizing ideas, building ideas, planning applying ideas and applying ideas) in designing mathematics tasks.

2. Method

This research is an explorative research with qualitative approach. Collecting data methods is using task-based interviews. The aims this reasearch is to explore what teachers think in making mathematical assignment (problem), and then this research is classified as making math problem. Participants in this study were Bibah (a fake name of different elementary school teachers in Pangkep district, south sulawesi with functional positions of teachers (baginner teachers) Bibah made a mathematical question, after depth observation refers to the framework in table 1 , Bibah got all four indicators.

To generate descriptions of each indicator, we conducted interviews with participants individually. Each interview was recorded with a video focusing on gesture, the interaction between the researcher and the teacher, and the result, while the audio recorder (recorder), was used to record interviews with participants before and after making assignments. Interviews were conducted several times to explore and conclude teacher consistency in making mathematical assignments. We designed guidelines of interviews on the previous research to reveal the thinking process of teachers in mathematical assignments.

3. Result and Discussion

Based on the indicator from [19], the researcher assigns a task for Bibah to create mathematical problems. Problems that are created by Bibah are presented in the following figure 1.

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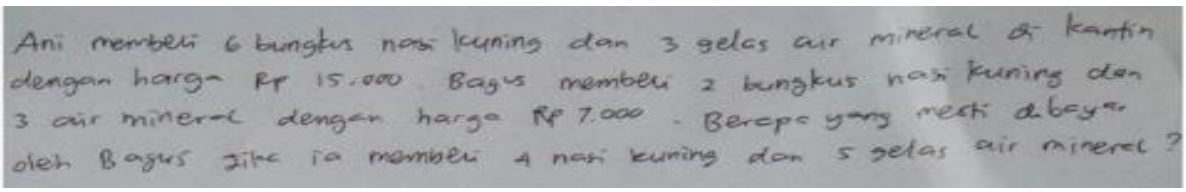

Figure 1. Problem generated by the Bibah

Based on the interviews, the creative thinking process of Bibah can be described as follows:

3.1. Creative thinking processes of Bibah is associated with the indicator of synthesizing ideas
In designing math tasks Bibah thinks first about the material and the early knowledge of students. Then connecting the material with various sources or it can be an actual event that has been experienced by the students so it can be an interesting for student. When connecting those things, it can be increasing the student's curiosity. After finding the event that has a correlation with the material, Bibah links the linear equations system of two variables with the context of the canteen

3.2. *The creative thinking process of Bibah is associated with building ideas*
By linking the actual things that students have known with the students' daily lives, it becomes the based for Bibah in building ideas to attract the students. With these considerations Bibah build the ideas with information about the problems related to the reality that exist in the school. Then Bibah makes a problem of two-variable linear equations system by linking information in the canteen.\

3.3. The creative thinking process of Bibah is associated with planning the implementation of ideas
According to the ideas that are synthesizing before to make a task, Bibah has many options in adapting the materials related to the school environment. Furthermore, in designing the application of ideas, Bibah is considering things that make students feel closer to the school environment, the fun things of the school, and absolutely the most familiar things for students. Therefore In designing the question, Bibah is considering a round solution, the degree of questioning and have more than one correct answer.

3.4. The creative thinking process of Bibah is associated with the application of ideas
In applying the idea, Bibah has adapted the material to the student environment. According to him, the important thing to consider in making the task is to connect the environment around the students. The information on the task is selected after the previous idea plans and compares the tasks he has made with the problems he has made so far. Bibah re-checking the problem that he has made, whether the problem has more than one answer, this is done because the Bibah modified the problem based on actual things experienced by students with the aim to increase the students confidence in answering math problems.

The results shows that the creative thinking process of Bibah in designing the mathematics task is more focused on the context situation that has been known by the students, it has several solutions and various answer, and noticed the students' abilities. In following up the task, teachers should be good enough at choosing tasks that focus on the context situation, the students' abilities and the learning objectives to provide opportunities and overall learning experience [1, 7, 9, 12, 13, 20]. It means that from the stages of the creative thinking process of Bibah that is formulated in table 1, it is entirely contains a context that close with student environment and their daily life.

4. Conclusion

Based on the results of the research that has been described, it can be concluded that the creative thinking process of Bibah in designing the math task to follow the sequence of ideas synthesis stage, building ideas, planning the implementation of ideas, idea synthesis, plan the application of ideas and application

of ideas. Bibah designed the task of mathematics with the stages that cannot be separated from how he utilizes the circumstances surrounding the student or the actual things experienced by students, besides that Bibah also compare the problems that have been made so far, by modifying the problem that has more than one correct answer with the aim to raises students' confidence.

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