The Level of Creative Thinking of Prospective Mathematics Teachers in Solving Basic Geometry Problems: Analysis and Strategies

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Abstract
Creative thinking ability is one of the most important 21st-century skills, especially in the context of problem solving. Creative thinking involves developing and combining ideas and innovative approaches to solve problems. Creative thinking is a process that occurs when someone comes up with new ideas. This study aimed to show prospective mathematics teachers' creative thinking in solving geometry problems. The research subject is the student class 2023 A, Department of Mathematics Education, PGRI Kanjuruhan University Malang. Type study This is a qualitative study, with the instrument being the researcher, a sheet test, guidelines for interviews, and documentation. The results are one subject study meets TKBK 2, 1 subject study meets TKBK 3, 1 subject study meets TKBK 4, and 1 subject study fulfils TKBK 5. Based on the results of the interview with the subject study with TKBK 2, 3, and 4, the conclusion is that students are not yet used to understanding and learning concepts, tangible objects, or real-world situations, so that difficult to develop creative ideas in solving geometry. Therefore, to improve the creative thinking skills of prospective mathematics teachers, a) Provide Open-Ended Practice Questions, b). Use of Learning Media, c). Project-Based Learning. Suggestions for further research are the need to study the creative thinking process of prospective mathematics teachers, so they can later determine strategies for developing the creative thinking skills of prospective mathematics teachers.
Keywords: The Level, Creative Thinking, Geometry Problems

Introduction

Creative thinking ability is one of the most important 21st-century skills, especially in the context of problem-solving (Arikan, 2017; Fajarwati & Ninawati, 2023; Ferdiani, 2024). In various fields, including education, creative thinking is important in finding innovative and effective solutions to complex problems (Aditya & Suparman, 2024). This is especially relevant in mathematics education, where problem-solving does not only involve the application of procedures or formulas but also demands creative thinking skills to develop new, unique and efficient approaches (Ferdiani et al., 2021). Creative thinking involves developing and combining ideas and innovative approaches to solve problems. Thinking creatively combines cognitive abilities to create (Fajarwati & Ninawati, 2023). Creative thinking involves intuitive and imaginative thinking to produce new, unique, and innovative ideas, concepts, or products (He, 2017). Thinking creatively is essential in facing future challenges (Anwar et al., 2023; Aytaç & Kula, 2022), because thinking creatively is a series of activities that cognitive individuals develop imagination, intelligence, insight, and ideas to face problems in find something new (Isaksen, 2023).

Creative thinking is a process that occurs when someone comes up with a new idea. The new idea can be a combination of ideas that have never existed before (Chen et al., 2009; He, 2017). When associated with creative thinking with the creative thinking process, the creative thinking process can be interpreted as a stage or process that combines logical thinking (convergent) and divergent thinking in solving problems. Divergent thinking can be used to find ideas to solve problems. Convergent thinking verifies these ideas and turns them into a solution. So, the process of creating ideas can be classified as divergent thinking. When thinking convergent, it will be more focused on a single answer. At this stage, it will benchmark how much the divergent process is passed in solving problems (He, 2017). Problem-solving is the core of mathematics learning, and students' success in mathematics is determined mainly by their ability to think creatively (Rahayuningsih et al., 2021). In education, this ability becomes increasingly important because teachers are not only tasked with delivering material but also guiding students to think critically and creatively in solving problems.

Based on Siswono's research (Siswono, 2011), the assessment assesses creative thinking skills by grading creative thinking skills in solving mathematical problems based on students' creative thinking products consisting of 3 aspects: fluency, flexibility and novelty. The stages of students' creative thinking refer to the stages of synthesizing ideas, building ideas, planning the implementation of ideas, and implementing these ideas. Activities at the stages of the creative thinking process in solving problems are more emphasized in generating ideas to solve problems, linking concepts or information used to solve problems, planning solutions, and using concepts to solve problems. The level of creative thinking skills to solve problems consists of 6 levels, starting from the lowest: level 0, level 1, level 2, level 3, level 4, and level 5.

However, many studies show that the creative thinking abilities of students and prospective teachers have not yet developed optimally (Amelia et al., 2018; Ferdiani et al., 2021; Syaiful et al., 2017). This can be caused by several factors, including learning approaches that still tend to focus on solving problems procedurally, a lack of opportunities to explore new ideas, and a lack of in-depth understanding of the creative thinking process itself (Ferdiani et al., 2021). As a result, students and prospective teachers are often trapped in linear patterns that hinder their ability to produce innovative solutions.

Several researchers have researched creative thinking skills (Herawati et al., 2023; Im et al., 2015; Jaquith & Hathaway, 2015). However, based on the literature review

conducted by researchers, previous research focused on students' creative thinking skills using three aspects, namely fluency, flexibility, and novelty. Fluency is the number of ideas that come from a person's mind. Fluency is a person's ability to apply various approaches to solving problems. Creative individuals are flexible in thinking and can easily abandon old ways of thinking and replace them with new ones (Jaquith & Hathaway, 2015). Novelty (originality) is the ability of individuals to produce questions that are different from one another in concept or context. This is a gap for researchers to research the level of creative thinking skills of prospective mathematics teachers in solving geometry problems.

The urgency to develop creative thinking skills in problem solving is not only related to the needs of learning in the classroom but also to prepare individuals to face real-world challenges that often do not have definite answers. By understanding the level of creative thinking, prospective teachers can be designed to be effective facilitators in guiding students to face these challenges (Siswono, 2011).Therefore, in-depth research is needed on how the level of creative thinking ability occurs in problem solving, especially in prospective teachers who will become future educators. This creative thinking ability is expected to be the basis for designing learning strategies that improve technical skills and encourage creativity and innovation in problem-solving. The difference between this study and previous studies is that this study focuses more on measuring the level of creative thinking of prospective mathematics teachers in solving geometry problems, so the purpose of this study is to analyze The Level of Creative Thinking of Prospective Mathematics Teachers in Solving Basic Geometry Problems.

Method

Study this to reveal the level of creative student prospective teacher in solving problem-solving geometry basis. So that this research is classified as qualitative research (Moleong, 1989; Rijali, 2019). Type study This is a case where the in-depth longitudinal examination is done to level creative student prospective teachers in solving the problems with the use of systematic ways of observation, data collection, analysis of information, and reporting the result. Subject study This is a prospective student teacher of Class 2023 A, Mathematics Education study program, totaling 24 students. The research instruments are tests, interview guidelines and documentation. Subject selection is based on test scores which are classified into low, medium, and high categories.

The procedure for data collection will use a test of material geometry. Then, results from the test will be analyzed and presented in data form. Qualitative data analysis is done with road Work with data, organizing data, selecting One Unity, synthesizing data, searching, and finding patterns, finding what is important and what is learned, deciding what can be served and withdrawing the conclusion from the data.

Results and Discussion

A study was conducted by giving a test to prospective mathematics teachers. The test contained questions about geometry and a discussion of spatial figures based on the level of students' creative thinking knowledge. The preparation of the test refers to creative thinking indicators to make it easier for researchers to measure the level of creative thinking of prospective mathematics teachers. Figure 1 shows questions about the test given to prospective mathematics teachers.

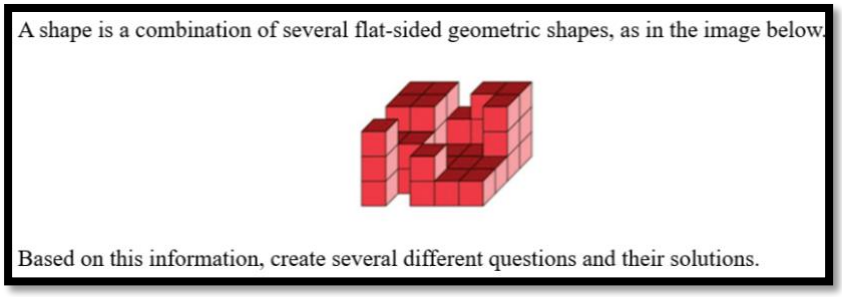


Figure 1. Creative thinking ability test questions

The next stage is to analyse the results of the creative thinking test of prospective teachers. After analyzing the results of the creative thinking test, the next step is to select research subjects using statistical methods and data quartiles to obtain subjects who have high, medium, and low thinking abilities. Based on the results of the subject selection, four research subjects were selected, which were used in the study. The results of this subject selection are presented in Table 1 below(Ferdiani et al., 2024).

Table 1. Subjects Study

Potential Research Subjects	Age	Gender	GPA	Category
ALA	22	Woman	3.44	Tall
NR	23	Man	3, 21	Currently
IP	22	Woman	3, 04	Currently
RR	21	Woman	2.89	Low

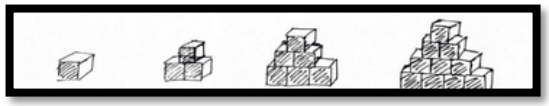
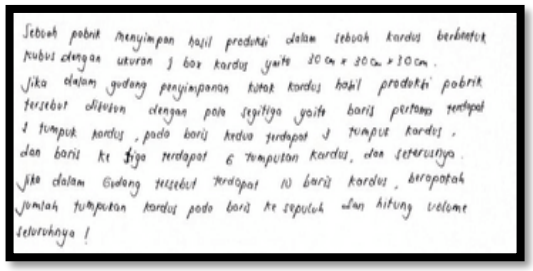
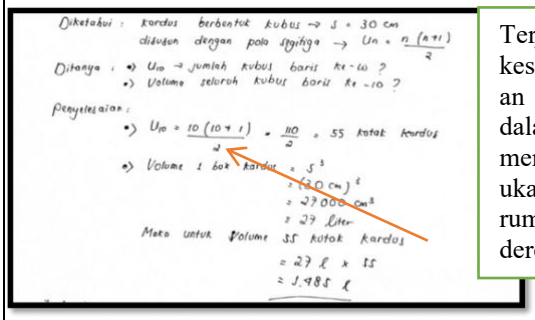
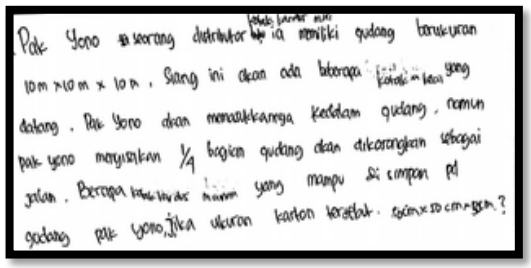
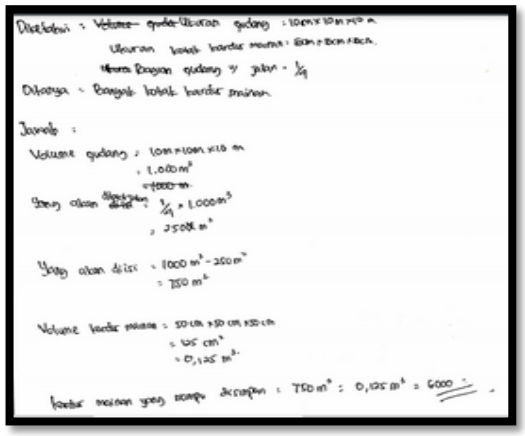
The next step is to analyze the results of the test to determine the level of ability to think creatively. Ability level thinks creatively to solve the problem, which consists of 6

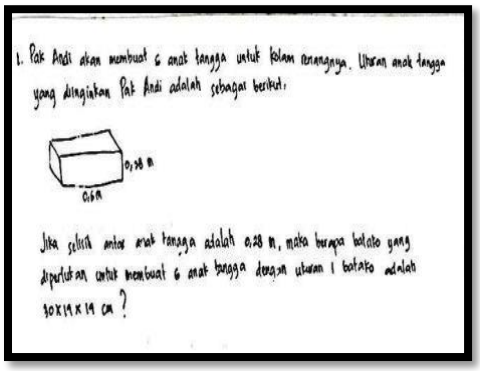
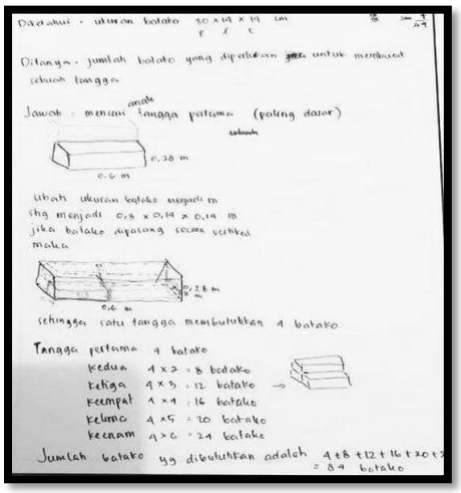
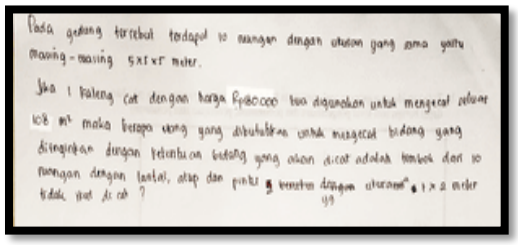
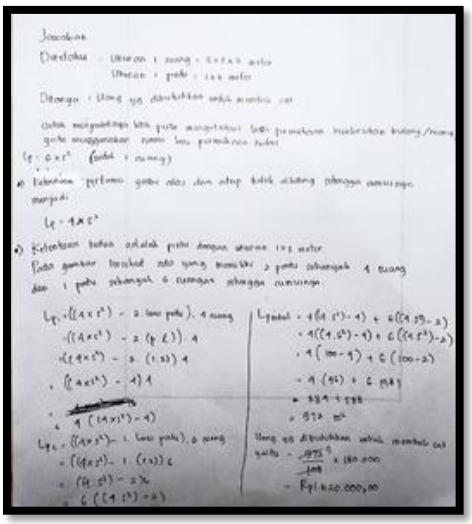
levels starting from the lowest: level 0, level 1, level 2, level 3, level 4, and level 5. The description is as follows:

1. Level 5: Assignment results show that the student fulfilled all criteria for product creativity. Students can synthesize ideas, generate new ideas from draft mathematics and real experience life, and apply ideas to build several problems and revise when they find obstacles.
2. Level 4: Task results: The student fulfils all criteria for product creativity. Students can synthesize ideas, generate new ideas from draft mathematics and a little bit of real life, and apply ideas to build several problems. They also revise when they find obstacles.
3. Level 3: Task results: The student fulfils all criteria for product creativity. Students can synthesize ideas, generate new ideas only from draft mathematics, and apply ideas to build several problems. They also revise when they meet obstacles.
4. Level 2: Task results: The student satisfied only one or two criteria for product creativity. Students can synthesize ideas from draft mathematics or experience life objectives and generate new ideas only from mathematics drafts or experience real life. Students do not yet bring up all the ideas for building several problems, but they can revise problems when they find obstacles.
5. Level 1: Task results in students how the only fulfil fulfils one criterion for creativity. Students cannot synthesize ideas from draft mathematics or experience life real but can generate new ideas only from mathematics drafts or experience real life. He hasn't used all the ideas to build several problems and also revised when they found obstacles.
6. Level 0: Task results in student Not satisfying all criteria product creativity. Students cannot synthesize ideas from drafting mathematics or experiencing real-life life and cannot generate new ideas. They only remember ideas (Siswono, 2004).

Based on the analysis results, the work subject so can be described in the following table.

Table 2. Work Results Subject

Research Subject	Research Subject Answers	Creative Thinking Ability Level	Description
RR	   Terjadi kesalahan dalam menentukan rumus deret	Meet TKBK 2.	1. RR Answer only fulfils One product's creativity, which is originality. 2. RR did not come up with all the ideas to solve the problem, which caused RR to make an error in finishing the problem.
IP	 	Fulfilling TKBK 3	1. Answer IP meets all criteria for product creativity. 2. IP can synthesize ideas and generate new ideas only from draft mathematics that has been studied.

NR	 	Fulfilling TKBK 4	1. NR meets all the criteria of a creative product. 2. NR can synthesize ideas and generate new ideas from mathematical concepts. 3. NR solves problems based on real-life experience (but Not deep).
ALA	 	Fulfilling TKBK 5	1. ALA meets all the criteria of a creative product. 2. Students can synthesize ideas, generate new ideas from mathematical concepts and real-life experiences, 3. ALA implements ideas without existing revisions and obstacles

Based on the results of interviews with the subject study with TKBK 2, 3, and 4, the conclusion is that students are Not yet used to Understanding and learning concepts of real objects or real, whereas geometry Lots serve abstract facts and concepts. Besides that, students Still apply the systems memorisation without understanding the concepts. Material Geometry is drafted as the basics that students must master. Geometry Lots serve abstract facts and concepts, and understanding them requires effort in thinking, analysing, and applying them in various ways.

Based on the results of the research and interviews with the subject of the study, we need experience in business. Toe's ability to think creatively is because of the student's prospective math teacher. This later will become a teacher in demand, and he can solve problems that can increase his students' ability to think creatively. For That, it takes effort to increase the ability to think creative prospective mathematics teachers; several strategies can be applied: 1). Solving Exercises Open-Ended Problems: Provide questions in geometry with Lots of solutions to push exploration and creativity (Masitoh & Prasetyawan, 2020). 2) Use of learning media: Tools such as device soft geometry dynamic allow prospective teachers to visualize and explore various solutions (Adiati, 2023; Basilotta Gómez-Pablos et al., 2017; Lou et al., 2017)(Ardithayasa et al., 2022; Diani et al., 2021; Ferdiani & Pranyata, 2022). 3). Learning Based on Project: Integrating draft geometry into a project, like designing architecture simple or analyzing patterns (Adiati, 2023; Basilotta Gómez-Pablos et al., 2017; Lou et al., 2017).

Conclusion and Suggestion

Based on the research results, it was found that one research subject met TKBK 2, 1 research subject met TKBK 3, 1 research subject met TKBK 4, and 1 research subject met TKBK 5. Based on the results of interviews with research subjects with TKBK 2, 3, and 4, it was concluded that students were not used to understanding and studying concepts, real or tangible objects, so they had difficulty developing creative ideas in solving geometry problems. Therefore, to improve the creative thinking skills of prospective mathematics teachers with a) Open-Ended Practice Questions, b). Utilization of Learning Media, c). Project-Based Learning. Suggestions for further research are the need to study the creative thinking process of prospective mathematics teachers, so they can later determine strategies for developing the creative thinking skills of prospective mathematics teachers.

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