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ANALYSIS OF THE CREATIVE THINKING ABILITY OF PGSD STUDENTS IN OPEN-ENDED PROBLEM-BASED GEOMETRY LEARNING

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ABSTRACT

Thinking creatively is an important skill in education, especially for Primary School Teacher Education Study Program (PGSD) students. This ability is crucial for understanding concepts in depth and solving problems innovatively in learning mathematics, especially geometry. However, many students still show limitations in generating creative ideas, especially in the aspects of originality and elaboration. Therefore, this research aims to analyze the creative thinking abilities of PGSD students in open problem-based geometry learning, which gives students the freedom to explore various solutions to solving geometric problems. This research uses descriptive qualitative methods with data obtained through interviews, observation, and document analysis. Research informants include lecturers, PGSD students, heads of study programs, librarians, and the curriculum development team at STKIP PGRI Trenggalek. The research results show that the open problem-based learning method effectively improves students' fluency and flexibility. However, several obstacles still required more intensive guidance and supporting technology in originality and elaboration. With the right approach, this method can be a solution to optimize students' creative thinking abilities in learning geometry.

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1. INTRODUCTION

In the era of globalization that continues to develop rapidly, the ability to think creatively is one of the most essential skills, especially in education (Nadia & Daesusi, 2023). The shift in the educational paradigm demands that higher-level thinking skills, including creative thinking, be developed as one of the main competencies students must possess. This ability allows individuals to generate new ideas, solve problems innovatively, and adapt to complex challenges. At the higher education level, especially in the Elementary School Teacher Education (PGSD) study program, the development of creative thinking skills has become increasingly crucial. PGSD students, as prospective educators, are not only required to understand the material but also to be able to teach concepts creatively to stimulate students' thinking skills at the primary level (Aprianingtyas, 2024).

This creative thinking ability is used to solve problems in Mathematics material. Geometry, one of the essential branches of Mathematics, is often considered challenging. This material relies on calculation skills and involves visualization, logic, and creativity in solving problems (Mutiara et al., 2022). In geometry, open-ended problem-based learning methods have great potential for developing creative thinking skills. This method allows students to explore various solutions, develop alternative thinking, and practice problem-solving skills innovatively.

However, in reality, the creative thinking ability of PGSD students, especially at STKIP PGRI Trenggalek, still faces various challenges. Based on initial observations, most students tend to show a linear mindset and are limited to standard procedures in solving geometry problems. This phenomenon indicates that the learning carried out is still conventional and does not facilitate the development of creativity (Sadaralam et al., 2023)In addition, students often need help proposing alternative solutions or innovative strategies when faced with complex and open geometry problems. Given the importance of their role as prospective educators who will teach future generations, this situation is a serious concern.

National data shows that the level of creative thinking ability of Indonesian students, especially in the field of Mathematics, is still below the international average. A study conducted by TIMSS (Trends in International Mathematics and Science Study) in 2019 showed that Indonesian students have weaknesses in creative thinking indicators, such as flexibility and elaboration in solving Mathematics problems (Sugandi et al., 2021). This result is also reinforced by the PISA (Programme for International Student Assessment) report 2022, which indicates the low ability to solve complex problems in Indonesian students. This low ability to think creatively directly impacts the effectiveness of geometry learning, especially when applying innovative learning methods such as open-ended problem-based.

Some basic concepts, such as flat builds, space builds, transformations, and coordinates, are often taught with less varied methods. Innovative geometry learning can provide a more immersive learning experience through visual exploration and manipulating geometric objects. Geometry material requires not only mastery of theory but also skills in applying concepts to solve real problems. This is where an open-ended problem-based approach is essential, which allows students to see geometry as a tool for understanding the natural world through creative problem-solving and not limited to a single answer (Abidin et al., 2018).

The open-ended, problem-based learning method encourages active student involvement in the learning process. This approach allows students to develop a deeper understanding of geometric concepts through exploration and discussion. Students are encouraged to formulate their problems, explore various solution strategies, and collaborate

in evaluating the resulting solutions. Thus, open-ended problem-based learning improves students' cognitive abilities and social and communicative skills.

Based on initial observations at STKIP PGRI Trenggalek, it was found that most students still tend to rely on direct guidance from lecturers when completing geometry tasks. They also point out the limitations of designing original and innovative solutions. Lack of exposure to open-ended, problem-based learning methods is one factor that hinders the development of their creative thinking skills. In addition, limited learning resources and the lack of application of technology in geometry learning are also obstacles that need to be overcome.

Previous research shows that open-ended, problem-based learning positively impacts students' creative thinking skills. For example, research (Fatmawati, 2023) this method of learning Mathematics can increase flexibility and originality in problem-solving. Similarly, a study by (Hamid, 2023) open-ended problem-based learning can improve students' ability to develop alternative solutions. Similar results were also found by (Klau et al., 2022), who mentioned that this method effectively increases creativity and strengthens the understanding of geometric concepts. Meanwhile (Kadir et al., 2022) Emphasized the importance of open-ended problem-based learning in increasing student involvement in the learning process, indirectly contributing to developing creative thinking skills.

Although various studies have shown the effectiveness of open-ended problem-based learning, most focus more on cognitive aspects such as understanding concepts and problem-solving strategies. In-depth research on students' creative thinking skills in the context of geometry learning still needs to be completed. In addition, previous research has not highlighted specific factors that affect the development of the creative abilities of PGSD students, such as the use of innovative learning media or technology support. To fill this gap, this study will focus more on analyzing students' creative thinking skills in open-ended problem-based geometry learning by emphasizing the specific context of STKIP PGRI Trenggalek. Novelty in this study explores the relationship between open-ended problem-based learning methods and the creative thinking ability of PGSD students in a specific educational environment, as well as offering a learning model that can be implemented practically.

This study aims to analyze the creative thinking skills of PGSD students in open-ended problem-based geometry learning at STKIP PGRI Trenggalek. With this research, effective strategies can be found to improve students' creative thinking skills and contribute to developing innovative learning models in higher education.

2. METHOD

The research method used in this study is qualitative descriptive. This approach was chosen to deeply understand how the creative thinking skills of PGSD students develop in open-ended problem-based geometry learning. This research aims to describe phenomena that occur naturally in the learning process and explore various factors that affect students' creative thinking skills. (Sugiyono, 2019). Data was collected through direct observation, in-depth interviews, and documentation. Observations were conducted to see firsthand how students responded to and solved open-ended problems in geometry learning. At the same time, in-depth interviews were used to explore the perspectives of students and lecturers regarding experiences and challenges in education. Documentation in the form of field notes and student assignments was also analyzed to strengthen the findings. (Sugiyono, 2021).

This study's primary and secondary data sources are primary and secondary. Primary data was obtained from interviews and direct observation of informants, while secondary data was in the form of related documents, such as semester learning plans, lecture contracts,

and student assignment results. The informants in this study include five main parties: (1) Lecturers in charge of elementary mathematics learning development courses who are responsible for designing and implementing open-ended problem-based learning; (2) PGSD students in the 5th semester who take the Elementary Mathematics learning development course; (3) The head of the PGSD study program who provides a policy perspective related to innovative learning methods; (4) Librarians who provide sources of literature to support learning; and (5) A curriculum development team responsible for competency-based curriculum design (Creswell & Creswell, 2018). The combination of these various informants provides a comprehensive overview of the implementation of open-ended problem-based learning methods and their impact on students' creative thinking skills.

The data analysis technique in this study uses descriptive qualitative data analysis, which involves data reduction, data presentation, and conclusion according to the (Matthew B. Miles, A. Michael Huberman, 2023) model. Qualitative data from interviews, observations, and documentation were analyzed in depth to describe the phenomena that occur in open-ended problem-based geometry learning. In addition, the quantitative data in the form of averages and percentages presented in the research results were obtained from creative thinking ability test instruments designed based on creative indicators (Fluency, Flexibility, Originality, Elaboration). This quantitative data was processed using simple descriptive statistical analysis to support the interpretation of qualitative results, provide an overview of the percentage of achievement of each indicator, and strengthen the study's conclusion.

3. RESULTS AND DISCUSSION

3.1. Results

The results of interviews with the informants in this study, consisting of lecturers in charge of elementary mathematics learning development courses, PGSD students, heads of PGSD study programs, librarians, and curriculum development teams, provided vibrant insights related to the application of open-ended problem-based learning in developing creative thinking skills. From interviews with lecturers, it was revealed that the open-ended problem-based learning method is considered an approach that can encourage students to think deeper and produce varied solutions. The lecturer explained that students can explore various approaches to solving geometry problems in this learning. This helps them see geometry from different perspectives and stimulates the emergence of new ideas. However, lecturers also admit that time limitations are often an obstacle to providing optimal guidance to students. The exploration process that should be in-depth and comprehensive sometimes needs to be improved due to limited time allocation, especially if students take longer to understand basic concepts before being able to innovate.

Students, as the main subjects of this study, provide diverse views regarding their experiences participating in open-ended problem-based learning. Most students feel this method encourages them to be more active and independent in learning. They are required to understand and apply the concept in the context of a real problem that often does not have a single answer. Students felt more challenged to collaborate with classmates, exchange ideas, and find the most effective solutions. However, some students need help with elaboration and originality. Some admitted that they often experience a stalemate when asked to provide an in-depth explanation or a completely new solution. Although the open-ended problem-based method offers space for creativity development, more intensive guidance and support are still needed to help students overcome these challenges.

The interview with the head of the PGSD study program provides a more strategic perspective on implementing this learning method. The head of the study program emphasized that the open-ended, problem-based method aligns with an institution's vision of producing innovative educators who can think critically. He explained that the curriculum at PGSD is designed to encourage students to become lifelong learners who can adapt to various educational challenges in the future. However, he also underlined that the success of this method is highly dependent on the readiness of lecturers and students. Therefore, the study program plans to provide further training for lecturers, especially in managing open problem-based learning effectively. In addition, he proposed the need to review the curriculum structure to be more flexible and provide enough space for students to explore their creative ideas.

The results of interviews with librarians found that access to learning resources also dramatically affects the success of open-ended problem-based learning. The librarian explained that the campus library has a reasonably complete collection related to geometry literature and innovative learning methods. However, the level of utilization by students is still relatively low. Many students rely more on the material lecturers provide, so they miss the opportunity to enrich their insights through additional references. Librarians also suggest that students use the technology available in the library more often, such as dynamic geometry software, to help them visualize concepts and develop more creative solutions.

The curriculum development team provides essential input on evaluating and developing open-ended problem-based learning. They emphasized that this learning requires a holistic evaluation approach, where students are assessed based on the final result and their thought process. The development team notes that one way to strengthen the effectiveness of this method is to implement continuous formative assessment. This assessment allows students to get constructive feedback to continue improving and developing their creative thinking skills throughout the learning process. In addition, the development team also proposes further integration of technology in geometry learning, such as using online platforms and computer-based simulations, which can provide a more interactive and immersive learning experience.

Overall, interviews with the informants revealed that the open-ended problem-based learning method has great potential to develop the creative thinking skills of PGSD students. However, its successful implementation requires support from various parties, ranging from lecturers and students to study program managers. With proper support, this method can be one of the most innovative and effective learning approaches for educators who face educational challenges in the era of globalization.

The study results show that the creative thinking ability of PGSD students in learning open-ended problem-based geometry is quite good, but there is still room for improvement. Most students can develop alternative solutions and show flexibility in solving a geometry problem. Many students still need to give more conventional and in-depth answers regarding elaboration and originality. This indicates that although open-ended problem-based methods provide opportunities to improve creative thinking skills, their implementation needs to be optimized with more structured guidance and supportive learning facilities. In addition, students' responses to this method are generally positive, and they feel more challenged and motivated to participate actively in learning.

3.2. Discussion

The ability to think creatively has become an essential topic in education, especially in the era of globalization that demands innovation and high adaptability. In higher education, especially in the Elementary School Teacher Education Study Program (PGSD), this ability has a vital role in forming prospective educators who not only master the material but also can teach concepts creatively and innovatively. In the context of learning Mathematics, especially geometry, the creative thinking ability of PGSD students is one of the crucial aspects. Geometry, as a branch of Mathematics, requires visualization skills, spatial understanding, and creativity in solving problems. However, students often need help learning geometry because learning is still focused on mechanical procedures and does not provide space for exploring ideas.

One of the practical learning methods for developing creative thinking skills is open-ended problem-based learning. This method allows students to explore various solutions to the problems without being tied to one correct answer (Kartikasari et al., 2022). In this approach, students face situations that challenge them to think of different ways of solving problems, analyze each approach, and develop innovative solutions. With this method, learning focuses on the final result and the thinking process students go through, which involves exploring ideas, critical analysis, and developing solutions appropriate to the problem's context.

Open-ended problem-based learning also allows students to look at a problem from multiple perspectives, encouraging them to think more broadly and flexibly. In practice, students can explore their previous experience and knowledge to formulate diverse solutions. This method allows students to test different approaches, reflect on their effectiveness, and choose the most appropriate solution. Although this method has proven effective in boosting students' creativity, the main challenge is helping them develop original solutions and refine their ideas. Students need adequate guidance to generate more detailed and in-depth ideas.

Therefore, more intensive support from lecturers is needed through guidance and constructive feedback. This guidance can help students generate ideas and develop and refine those ideas into mature and innovative solutions. In addition, additional training, such as workshops or technology-based simulations, can be provided to strengthen students' creative thinking skills (Simanjuntak et al., 2021). With supportive guidance and facilities, students will be better prepared to face the challenges of open-ended problem-based learning to maximize their creative potential in solving complex and relevant geometry problems in the real world.

Although the study results show that open-ended problem-based learning has great potential in developing creative thinking skills, its implementation is inseparable from various challenges. One of the main challenges is the limited time available in the learning process. Many lecturers and students feel that more than the time allocated to each learning session is needed to explore the problem in depth. As a result, exploration and discussion often stalls before students can develop their creative ideas.

Limited resources, such as lack of access to learning technology, are also obstacles. Technology, such as dynamic geometry software, can help students visualize geometry concepts and explore various solutions interactively. However, not all classes have access to this technology, so students must rely on traditional methods that tend to limit their creativity. This is exacerbated by lecturers' need for more training in innovative learning technology. The difference in individual abilities between students is also a challenge in itself. Some students can quickly adapt to open-ended, problem-based learning methods and show significant improvements in creative thinking. However, some students take longer to understand concepts and develop solutions. Students who need more confidence often

hesitate to put forward their ideas, significantly if they differ from their peers. This shows that a supportive learning environment is critical to actively encourage all students to participate and develop their creative thinking skills.

Collaboration between students is one of the essential elements in open-ended, problem-based learning. In the discussion group, students can exchange ideas and provide input on proposed solutions. This process not only helps them to enrich their perspective but also trains their communication and cooperation skills. Based on the interview results, students who actively collaborate in groups show better creative thinking skills than those who work alone. They are more open to criticism and feedback, which ultimately helps them to develop better and innovative solutions.

Feedback from lecturers also plays a vital role in developing students' creative thinking skills. Specific and constructive feedback can help students understand their weaknesses and provide guidance for improvement (Kardoyo et al., 2020). For example, lecturers can give feedback on how students explain their solutions or provide suggestions for developing more profound ideas. This process helps students to continue learning and improve their abilities in every aspect of creative thinking. To optimize the development of the innovative thinking skills of PGSD students, several strategies can be applied:

1. Lecturers must increase the variety of assignments and problems given to students. These problems must be designed to trigger students to think creatively and explore various solutions.
2. Formative evaluation needs to be applied consistently in the learning process. By providing continuous feedback, students can continue to improve and develop their creative thinking skills.
3. The use of technology in learning needs to be improved. Technology can provide a more interactive learning experience and help students understand complex concepts. For example, dynamic geometry software can help students visualize geometry concepts and test various solutions more easily.
4. Training and workshops on developing creativity in Mathematics learning must be held regularly. This will help students and lecturers to adopt more innovative and effective learning methods.

The results of this study show that open problem-based learning effectively improves students' creative thinking skills, especially in the aspects of flexibility and fluency of ideas. However, there are still challenges in the elements of originality and elaboration. This finding aligns with the research, which shows that open problem-based learning methods can encourage students to develop various alternative solutions in learning mathematics, especially in geometry material. In addition, research by (Ramadhani et al., 2020) also found that the application of this method not only improved creative thinking skills, but also strengthened concept understanding through deeper exploration. Both studies reinforce the conclusion that open problem-based learning is an effective approach to encourage creativity and innovation in the learning process, although it still requires support in the form of intensive guidance and adequate use of technology to overcome the challenges.

4. CONCLUSION

This study shows that open-ended problem-based learning has great potential in developing the creative thinking skills of PGSD students, especially in the context of geometry learning. This method allows students to explore various solutions, think flexibly, and generate innovative ideas. However, the study's results also revealed that originality and elaboration in creative thinking still require special attention. Students tend to produce

conventional and less in-depth solutions, which indicates the need for more intensive guidance from lecturers. In addition, supporting technologies such as dynamic geometry software can help enrich students' learning experience, allowing them to develop more creative and detailed solutions.

Educational institutions should consider providing supportive learning facilities and training for lecturers in managing innovative learning to optimize the implementation of open-ended, problem-based learning. Consistent formative feedback is also essential to help students develop their ideas better. With structured implementation and adequate support, this method is expected to improve students' creative thinking skills and prepare them to become future educators who are innovative and adaptive to the challenges of the world of education. Further research is suggested to explore broader technology integration and more effective evaluation strategies in open-ended problem-based learning.

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