Improving Students' Creative Thinking Ability by Applying Project Based Learning in Mathematics Learning

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Abstract

This study aims to explore the impact of implementing Project Based Learning (PJBL) in improving students' creative thinking skills in mathematics learning at upper secondary schools. The research method used was a pre-test post-test control group experimental research design, which involved two groups of students: an experimental group that applied PJBL and a control group that received mathematics learning with conventional methods. The research instruments used were creative thinking ability test, observation, and interview. The results showed that students who engaged in mathematics learning with PJBL experienced a significant improvement in their creative thinking ability compared to students who followed conventional learning. In addition, interviews with students and teachers also showed that PPA provided a more interesting and relevant learning experience for students, and enabled the development of creative thinking skills effectively. These findings provide strong support for the use of PPA as an effective learning strategy in improving students' creative thinking ability in mathematics learning in the school environment.

Keywords: Creative Thinking Ability; Project Based Learning; Mathematics Learning

Introduction

Education is the process of simulating different human situations with the aim of empowering oneself (Wulandari, 2022). Without education, human life would not be organized. As life becomes more sophisticated and the times more demanding, the role of education is seen as increasingly important. Involved in the world of education, including managers, locations, organizers, educators or teachers, facilities and infrastructure, media, and students or learners who are the future successors of the nation that occupies this world. Education is one of the national development efforts to make a country's life smarter and improve the quality of its human resources. According to Permendikbud Number 22 of 2016, the educational process, namely learning, should be carried out in an interactive, challenging, exciting, and fun way that stimulates students' active participation and their desire to provide services and opportunities to develop student creativity (Chairunnisa, et al, 2020).

Smart Factories, Industrial Internet of Things, Smart Industry, or Advanced Manufacturing are evidence of the rapid development of digital technology today (Octaviyani, et al, 2020). This characterizes the changes of the 21st century, where all countries compete in a highly dynamic global market. The 21st century is the century of science and technology infrastructure, and a nation's human resources are required to have various forms of skills, including the ability to think critically and solve more and more problems (Dewi, 2019). The Partnership for 21st Century Skills emphasizes that 21st century learning must teach 4 competencies, namely communication, collaboration, critical thinking, and creativity (Nurhayati, et al., 2024).

In the era of globalization and rapid technological development, the ability to think creatively is becoming an increasingly important skill for students to succeed in their future personal and professional lives, where the ability to think creatively is becoming increasingly crucial in solving complex and innovative problems (Khasanah & Herina, 2019). Mathematics, as one of the core subjects in schools, is often regarded as a discipline that requires strong conceptual understanding and careful problem-solving skills (Dwijayanti, et al., 2024). However, sometimes traditional learning approaches tend to emphasize memorization and routine application without providing sufficient space for students to develop their creative thinking skills. Technological advances and changes in labor market needs demand that mathematics education not only teaches conceptual understanding, but also fosters critical, analytical, and creative thinking skills in students (Akbar, et al., 2023).

In this context, learning approaches that emphasize practical experience and application of knowledge in real contexts, such as Project Based Learning (PJBL), are relevant and effective. PJBL allows students to learn while doing challenging projects, requiring creative problem solving, team collaboration, and reflection on the learning experience. On the other hand, Project Based Learning (PJBL) has been recognized as one of the effective learning methods in stimulating students' creative thinking skills (Faslia, et al, 2023). In the context of mathematics learning, PPA provides opportunities for students to engage in projects relevant to real life, which require the application of mathematical concepts in real situations. As such, it not only enhances students' conceptual understanding but also develops their ability to think creatively, collaborate and solve problems.

However, despite its positive potential, the implementation of PPA in mathematics learning is still uneven in many schools. Many teachers are still hesitant to implement PPA due to concerns about a crowded curriculum, difficult evaluation or limited resources. Implementing PPA in mathematics learning remains a challenge for most educational institutions. There is an urgent need to investigate the effectiveness of PPA in improving students' creative thinking skills in the context of subjects that are often considered abstract and difficult to understand such as mathematics (Ramadhan, 2023). Therefore, research that explores the effectiveness of PPA in improving students' creative thinking skills in the context of mathematics learning is very important.

The application of Project Based Learning (PJBL) in mathematics learning not only strengthens students' conceptual understanding, but also plays an important role in improving their creative thinking ability (Ansya, 2023). By utilizing the potential of PPA, teachers can create a learning environment that stimulates and supports the holistic development of students' mathematical creative thinking skills. This not only assists students in gaining a deeper understanding of mathematics, but also equips them with the necessary skills to face complex challenges in real life. Based on the problems that have been described, this study aims to analyze the impact of implementing Project Based Learning in improving students' creative thinking skills, especially in mathematics learning. The results of this study are expected to provide new insights for educators, curriculum developers, and educational stakeholders to develop more effective learning strategies in producing graduates who are ready to face future global demands.

Method

This study used quantitative and qualitative approaches to gain a comprehensive understanding of the impact of implementing Project Based Learning (PJBL) in mathematics learning on students' creative thinking skills. The pre-test post-test control group experimental research design was used to compare students' creative thinking skills before and after implementing PJBL in mathematics learning (Sugiyono, 2017). In addition, a qualitative approach was also used to explore the experiences of students and teachers related to the implementation of PPA. The research subjects were students of class VIII MTs N 2 Batanghari.

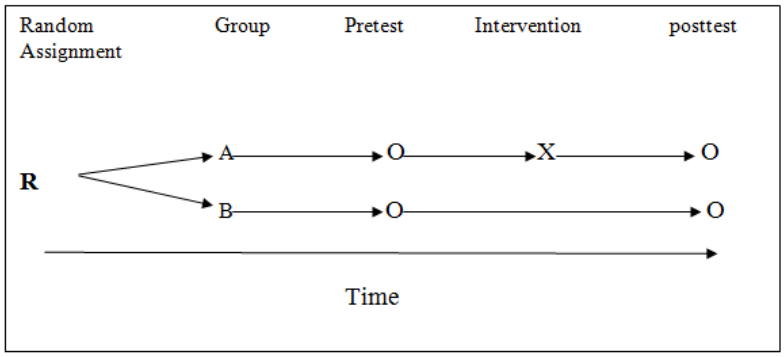

Figure 1. Research design

Result and Discussion

The research was conducted on class VIII students of MTs N 2 Batanghari where the control class numbered 30 people and the experimental class numbered 32 people. Students are given an essay test to measure creative thinking skills that are done twice, namely pretest and posttest using the same questions. In each class both experimental and control classes were given tests with the same items with circle learning material, to collect hypothesis testing data, researchers taught the phytagorean theorem material in the experimental and control classes 3 times each meeting, namely 1 time carried out for the teaching and learning process, 1 more time used for the project completion process and 1 more time used as research data in the form of descriptions.

The creative thinking skills test was conducted at the end of the learning process with 3 meetings. The items used as instruments have been tested for validity, difficulty level, differentiation, and test reliability. The creative thinking skills test used a description form test as many as 10 questions from 20 questions that had been tested instrument. The sempel answers from both groups are the results of creative thinking skills research. In terms of student learning outcomes based on predetermined assessments in accordance with indicators of students' creative thinking skills, the following data were obtained.

Table 1. Comparison of Pretest and Posttest Results of Experimental and Control Classes

Indikator	Kelas Eksperimen		Kelas Kontrol	
	Pretest	*Posttest*	*Pretest*	*Posttes*
Berpikir Lancar	46%	63%	40%	48%
Berpikir Orisinal	38%	41%	20%	35%
Berpikir Luwes	40%	52%	37%	45%

Berpikir Elaboratif	27%	40%	30%	34%

Based on table 1, it can be seen that the increase in creative thinking ability of each indicator in the experimental class and control class. At the pretest stage, it can be seen that the experimental and control classes basically have almost the same creative thinking skills. in some indicators, it can be seen that there are more superior in each experimental and control class. After being given treatment by applying Project Based Learning (PJBL), the creative thinking ability of the experimental class experienced a significant and quite high increase. While the control class also experienced an increase, but not too significant. The increase in the control class could have occurred due to the repetition of material so that it could refresh students' memories, but they were not focused on creative thinking skills.

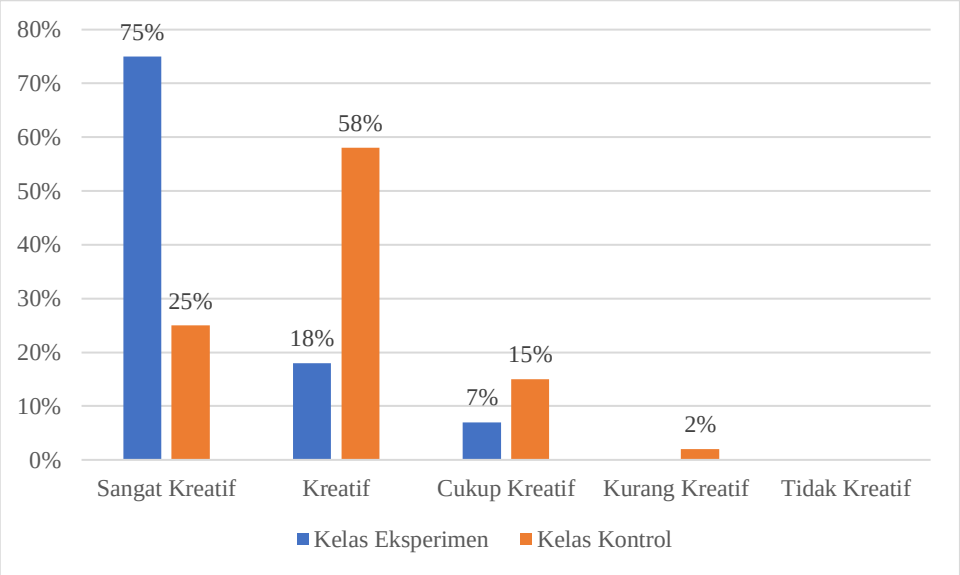

Figure 1. Diagram of Creative Thinking Ability of Experimental Class and Control Class

Figure 1 shows the percentage of students in the classification of creative thinking skills. In the experimental class there were 75% of students in the very creative category, 18% of students were creative, 7% of students were quite creative and there were no students in the less creative and uncreative categories. In the control class, 25% of students were very creative, 58% of students were creative, 15% of students were quite creative, 2% of students were less creative and there were no students who were not creative. So it can be concluded that there is a significant difference between the experimental class that applies Project Based Learning (PJBL) and the control class that applies conventional learning.

The application of the PjBL model with an online setting familiarizes students to work on learning projects given independently. This learning requires students to be more active in digging up information from several references to facilitate the learning project. The use of learning models that have compatibility with problems and learning environments and varied models can have an impact on learning activities, especially mathematics learning so that learning can be more meaningful and interesting enough (Syakur et al., 2020). Problem-based learning model is a model that can involve students to be more active both physically and mentally (Pratiwi et al., 2021). The Project Based Learning (PjBL) learning model is an innovative learning model, which emphasizes contextual learning through complex activities

that allow students to increase understanding in the knowledge they learn so that it can support various thinking abilities of students (Nurhadiyati et al., 2021; Pratiwi et al., 2021).

The learning stages in the PjBL model familiarize students to work together, discuss, and think about new things which causes students' creativity to increase. In line with the opinion of Putri, Koeswanti, & Giarti (2021) who stated that the PjBL model requires students to be active in participating in learning and fostering cooperation, tolerance, discipline, honesty, and self-confidence. The PjBL stage which consists of introductory activities, core activities, and closing activities in which there are steps designed using learning media that can foster student creativity (Bahrudin, 2018).

Conclusion

Based on data analysis, it can be concluded that the application of Project Based Learning (PjBL) is effective in improving students' creative thinking skills in mathematics learning. Students involved in project-based learning showed significant improvement in creative thinking ability and understanding of mathematics concepts compared to conventional learning methods. The results of this study provide strong support for the integration of PjBL in the mathematics curriculum to improve the quality of learning and student learning outcomes.

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