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APPLICATION OF PROJECT-BASED LEARNING MODELS IN INCREASING MATHEMATICAL CREATIVE THINKING ABILITY IN GEOMETRY COURSES OF PLANE FIGURE AND POLYHEDRA FOR STUDENTS SEMESTER IV MATHEMATICS PROGRAM

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ABSTRACT

Students still have difficulty in understanding the mathematics concepts in improving mathematical critical thinking skills, so there is a need for learning innovation by applying project based learning model. The purpose of this study was to find out the responses and learning outcomes of students with the application of project based learning model in improving creative and mathematical thinking skills in geometry courses of plane figure and polyhedra. This study was an action research. The subjects in this study were fourth semester students of the Mathematics Education Study Program, FKIP Universitas PGRI Mahadewa Indonesia for the academic year 2022/2023. The object of this research was the study and understanding of geometry courses of plane figure and polyhedra with the project based learning model. Two cycles were done in this study and each cycle went through four stages of activity namely: (1) planning, (2) action, (3) observation, and (4) evaluation and reflection. The results showed that there was an increase in each cycle, the score at the initial reflection was 63.0, in the first cycle it became 71.0, and in the second cycle it increased to 77.0. Classical completeness increased from 30.0% in pre-cycle became 60.0% in cycle I, and 90.0% in the cycle II. The results of observations towards student responses in the first cycle were 70.9 and in the second cycle were 79.7. Thus it can be concluded that (1) the application of Project based learning model can improve student learning outcomes, (2) there is a positive response to the application of the Project based learning model in improving learning outcomes in geometry courses of plane figure and polyhedra.

Keywords: project based learning; mathematical creative thinking; geometry; plane figure and polyhedra

1. Introduction

Minister of National Education Regulation Number 69 of 2013 states that one of the aims of the 2013 curriculum is to create students who have the ability to think creatively. Until now, many learning models have been introduced that stimulate students to think critically and creatively. However, findings in the field show that there are still many lecturers who implement a teacher/lecturer-centred learning system, thereby triggering students' weak creative thinking abilities (Fitrina, T., Ikhsan, M, 2016). A lecturer-centred learning approach is an approach that does not support efforts to develop students' creative thinking abilities (Sudarma, 2013: 48). So there needs to be motivation to train students to think creatively (Fitriarosah, N, (2016).

The ability to think creatively is the ability to generate new ideas or ways of producing a product. The ability to think creatively has the following characteristics: (1) being able to generate many ideas, answers, questions, or solving problems; providing many ways or suggestions for doing various things, (2) being able to change your approach or way of thinking; (3) able to give birth to new and unique expressions; adding or elaborating in detail on an object, idea, or situation so that it becomes more interesting; and (4) able to make decisions

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regarding open situations (Williams in Munandar, 1992: 98).

According to Wallas, as mentioned by Satiadarma & Waruwu (2003: 112), the creative thinking process flows through four stages, namely: (1) preparation, namely defining the problem, goal or challenge; (2) incubation, namely digesting the facts and managing them in the mind; (3) illumination, namely encouraging ideas to come to the surface, (4) verification, namely ensuring that solutions can solve problems. External stimulation is the most important part that can encourage human creative thinking abilities. This stimulation can arise from the learning model applied to students, so that they are able to develop their creative thinking abilities (Sudarma, 2013: 13). One learning model that can be applied to stimulate students' creative thinking abilities is the project based learning model. Project based learning is a comprehensive approach that provides guidance for students, works individually or in groups, and relates to real-world topics. In this learning, students are trained to carry out analysis of problems, exploration, gathering information, interpretation and assessment of the projects they are working on (Taniredja, H. Tukiran et al, 2015). This learning model requires students to create projects related to related courses. Projects in Project based learning are built based on student ideas as an alternative form of solving certain real problems, so that students experience the process of learning to solve problems directly Astri May Handayani, et al., 2021).

The advantages of the Project based learning model according to Sani (2014: 177) include being able to improve students' ability to solve problems. Students' ability to solve problems is one of the characteristics of creative thinking (Aminullah, 2017). Thus, it can be seen that one of the advantages of the project based learning model is that it can trigger the emergence of students' creative thinking abilities (Hadi Suwono, 2018). The indicators of creative thinking that will be measured are (1) fluent thinking, namely being able to generate many ideas, answers, questions or problem solutions and provide many ways or suggestions for doing various things; (2) original thinking, namely being able to give birth to new and unique expressions; (3) the ability to evaluate, namely analyzing problems critically (Afriana, et al, 2016).

The ability to think creatively in mathematics is the ability to express ideas in solving flat geometry and space problems. One way to measure creative thinking abilities is with open questions, namely questions that have various solutions or completion strategies (Hesti Noviyana, 2017). Another way is the problem posing method, namely creating problems, questions or statements related to certain mathematical problems or situations.

From the above background, the aim of this research is to find out student responses and whether the application of the project based learning model can improve creative and mathematical thinking skills in flat and space geometry courses for students in the fourth semester of the Mathematics Education Study Program, FKIP Universitas PGRI Mahadewa Indonesia academic year 2022/2023.

2. Research Methods

This classroom action research was carried out at the Mathematics Education Study Program, Faculty of Teacher Training and Education, PGRI Mahadewa University, Indonesia. The research time is 2 months from October to November 2022 which is adjusted to the academic calendar and lecture hours for flat and space geometry courses on campus.

The subjects in this action research were students in the fourth semester of the Mathematics Study Program, FKIP, PGRI Mahadewa University, Indonesia, academic year 2022/2023. The object of this research is a study of understanding flat and space geometry courses using the project based learning model. This research also discusses student responses in learning flat and space geometry courses in the classroom. In this research two cycles were used and each cycle went through four stages of the activity process which included (1) planning, (2) action, (3) observation, and (4) evaluation and reflection (Arikunto, Suharsimi et al, 2016).

At the data collection stage, instruments are used which can be done by studying documentation or notes that support the research being carried out (Mardalis, 2008:74). The data collection technique in this research uses test and observation methods. Data collection in cycle I and cycle II was carried out using the technique of assessing student test results as numerical data, while data collection used observation techniques for qualitative data.

The data analysis used is a quantitative data analysis technique. This analysis technique can be carried out using descriptive statistics which

consists of data portrait analysis and data central tendency analysis (Anggoro, 2008:6.12). In cycle I and cycle II the analysis technique is determined by the percentage and average of the scores obtained by students so that the results of the analysis can be used to develop action plans for the next class according to the existing cycle. This analysis is carried out by lecturers in order to find out students' scores or grades during lectures.

The data obtained from cycle I and cycle II activities are still raw scores on test answers taken by students so the data needs to be processed using the steps (1) determining the ideal maximum score (SMI), (2) scoring the test and creating conversion guidelines , (3) determine the predicate criteria, and (4) find the average score.

The reference criteria for success in this research is that the class average score reaches a minimum standard of 70 with the majority (75%) of students being able to get a score of 70 - 100 and more than 75% of students having a high response in the lecture process activities.

3. Results and Discussion

Research Result.

1. Initial Reflection Results

Before using the Project based learning model, students' learning outcomes in flat and space geometry courses were still relatively low. This is evident from the results of the pre-cycle scores, namely that only a few students got good grades and the rest got fair grades, some even got poor grades. The results of the initial reflection of 10 students and only 3 students were declared complete, while 7 students were declared incomplete in answering flat geometry and space questions. This can be seen from the data (1) 30.0% or 3 students received a good predicate, (2) 50.0% or 5 students received a fair predicate, (3) 20.0% or 2 students received a poor predicate. with student completion only reaching 30.0%. Therefore, it is necessary to redesign learning in the classroom by implementing the Project based learning model.

2. Results of Cycle I Research

In the first cycle of research, data was obtained from the learning outcomes. The results of the abilities of 10 students who took the test, 6 people were declared complete and 4 people were declared incomplete. The average score obtained by students according to the data on their ability to answer flat and space geometry questions in cycle I was 71.0 and student completion reached 60.0%. As a result of observing responses from 10 students, 5 students were declared complete and 5 students were declared incomplete. This can be seen from the data (1) 20.0% or 2 students received a very good title, (2) 30.0% or 3 students received a good title, (3) 40.0% or 4 students received a good title. sufficient, (4) 20.0% or 2 students received a poor rating. The average score obtained by students according to the results of student response observation data in cycle I was 70.9 and student completion reached 50.0%

. Results of Cycle II Research

The test results of students who took part in practice questions on flat geometry and space material using the project based learning model can be seen that out of 10 students, 9 students were declared complete and 1 person was declared incomplete. This can be seen from the data (1) 40.0% or 4 students received a very good title, (2) 50.0% or 5 students received a good title, (3) 10.0% or 1 student received a good title. Enough. From the data obtained, it can be seen that the total score of the second cycle test results reached 770 with an average score of 77.0 and the completion of 9 students or 90.0% has shown a significant increase.

Data from response observations revealed that out of 10 students, 9 students were declared complete and 1 person was declared incomplete. This can be seen from the data (1) 50.0% or 5 students received a very good title, (2) 40.0% or 4 students received a good title, (3) 10.0% or 1 student received a good title. Enough. The average score obtained by students according to the results of student response observation data in cycle II was and 79.7 and student completion reached 90.0%

Table 1. Comparative data on pre-cycle, cycle I and cycle II learning outcomes regarding the application of the project based learning model to improve learning outcomes in flat and spatial geometry courses

Learning Outcome Data	Comparison of Test Results		
	Pre-cycle	Cycle I	Cycle II
Total	630	710	770
Mean	63.0	71.0	77.0

Based on the data on the predicate criteria for the ability to answer flat and space geometry

questions in the pre-cycle, cycle I and cycle II, it can be seen that the average score obtained in the pre-cycle was 63.0, increasing to 71.0 in cycle I, and increasing again to 77. .0 in cycle II. The research results obtained have met the specified success indicators, pre-cycle completion was 30%, then increased to 60.0% in cycle I, and increased again in cycle II to 90.0%, namely the results of student ability in cycle II were above 75 % so that this research ended with two cycles.

Table 2. Comparative Data of Observation Results of Student Responses in Cycle I and Cycle II towards the Implementation of the Project Based Learning Model to Improve Learning Outcomes in Plane and Space Geometry Courses

Data from Observation	Results Comparison of Test Results	
	Cycle I	Cycle II
Total	709	797
Mean	70.9	79.7

Based on the data table above, it can be seen that data from observations of responses among students (1) The average score obtained from observations of responses from students in the fourth semester of the Mathematics Study Program in cycle I was 70.9 and in cycle II it increased to 79.7. The increase was 6.8. (2) The results of research from cycle I and cycle II showed that there was an increase in the response of all 8 students, 1 person remaining, and a decrease of 1 person. (3) The number of students whose grades have been completed is 9 people and the number of students whose grades have not been completed is 1 person with classical completeness of 90%.

Discussion

The results of the first cycle reflection show that the learning outcomes that have been implemented are classified as sufficient with the average score obtained reaching 71.0 with a classical total of 60.0% and the results of observing student responses obtained an average of 70.9 with a classical total of 50.0 %.

Based on the results of the first cycle test which then moved on to cycle II, it showed that there was an increase in scores after the second cycle learning process was carried out. This increase can be seen from the learning results of cycle II which reached an average of 77.0 with a classical total of 90.0% and the results of observing student responses obtained an average of up to 79.7 with a classical total of 90.0%. This success is of course supported by the Project based learning model and the learning process for flat Geometry and space courses in the classroom is carried out correctly

From the results of research using the Project Based Learning (PjBL) learning model, it was declared successful in improving the ability of learning outcomes in flat and space geometry courses for students in the fourth semester of the Mathematics Study Program, FKIP Universitas PGRI Mahadewa Indonesia, academic year 2022/2023. This can be seen from the average comparison value of pre-cycle, cycle I and cycle II. The score obtained by students in pre-cycle activities was 63.0, then increased in cycle I to 71.0, and increased again in cycle II to 77.0. When compared, the average score increased from pre-cycle to cycle I by , and from cycle I to cycle II increased by 8.0. Completion of student learning outcomes in cycle II was declared successful because of the 10 students who took the test, 9 people or 90.0% of students achieved a complete score. Therefore, this research has met the specified success indicators. The application of the Project based learning (PjBL) learning model can increase the response of students in the fourth semester of the FKIP Mathematics Study Program at PGRI Mahadewa Indonesia University for the 2022/2023 academic year in terms of their ability to improve learning outcomes in flat and spatial geometry. This can be seen from the results of the average score resulting from observations of student responses which reached 70.9 in the sufficient category in cycle I and then increased in cycle II to 79.7 in the good category.

Choosing the right learning model is one of the efforts that can be made by a lecturer to achieve the expected student competency results. Project-based learning is a learning model that uses projects/activities as media (Noviyana, H, 2017).

The project based learning (PjBL) learning model provides opportunities for lecturers to manage learning in class by involving project work (Ika Wahyu Anita, 2017). Project work contains complex tasks based on problems (problems) as the first step in collecting and integrating new knowledge based on experience in real activities and requires students to carry out design activities, solve problems, make decisions, carry out investigative activities, and provide opportunities for students. to work independently

or in groups (Fitrina, T., Ikhsan, M., 2016). The final result of the project work is a product, written or oral report, presentation or recommendation. With the steps that have been taken above, the project-based learning model can improve student learning outcomes and improve problem-solving abilities

4. Conclusions

Based on the results of the research report, it can be concluded that (1) Research using the Project Based Learning (PjBL) learning model was declared successful in improving learning outcomes in flat and space geometry courses. This can be seen from the average comparison value of pre-cycle, cycle I and cycle II. Therefore, this research has met the specified success indicators. So the application of the Project based learning (PjBL) learning model can improve student learning outcomes in flat and space geometry courses for mathematics students in the fourth semester of the mathematics study program for the 2022/2023 academic year. So the application of the project based learning (PjBL) learning model can improve creative and mathematical thinking skills in flat and space geometry courses for students in the fourth semester of the FKIP Mathematics Study Program, Universitas PGRI Mahadewa Indonesia, academic year 2022/2023. (2) The implications of implementing the Project based learning (PjBL) learning model can increase student responses in improving learning outcomes in flat and space geometry courses. This can be seen from the increase in each cycle, so there is a positive response from students towards the application of the Project Based Learning (PjBL) learning model to improve learning outcomes in flat and space geometry courses for students in the fourth semester of the Mathematics Study Program for the 2022/2023 academic year.

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