JPPIPA 9(11) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Application of PjBL (Project Based Learning) Based Physics Learning Model to Improve Collaboration Skills and Creative Thinking Ability of Students

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Received: September 11, 2023
Revised: October 9, 2023
Accepted: November 25, 2023
Published: November 30, 2023

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DOI: 10.29303/jppipa.v9i11.5275

Abstract: This study aims to determine the implementation of learning using the Project Based Learning model in each cycle to improve collaboration skills and creative thinking skills of SMAN 1 Kampar Timur class XI students in Physics learning. This research can contribute in the form of additional discourse to enrich knowledge in the field of education, especially in the development of science learning and can be a reference and alternative for teachers in the use of learning models, so that physics learning activities become more innovative and can stimulate students' creative thinking, so that there is an increase in the efficiency and effectiveness of physics learning activities, especially in fluid materials. Data collection techniques in this study are using observation and test methods. Based on the results of research that has been conducted, it can be concluded that the use of the project based learning (PjBL) model has a significant influence on students' collaboration skills and creative thinking abilities. Improved Collaboration Skills Students in the first cycle of the first meeting got an average score of 63.03 in the poor category, in the second meeting got an average score of 65.00 in the poor category, in the third meeting got an average score of 70.45 in the good enough category, and in the fourth meeting got an average score of 70.83 in the good enough category. In Cycle II the first meeting got an average score of 82.19 in the good category, in the second meeting got an average score of 83.48 in the good category, and in the third meeting got an average score of 86.59 in the good category. The ability to think creatively of students also increases in each cycle. In cycle I got an average score of 80.42 in the creative category and in cycle II got an average score of 83.12 in the very creative category.

Keywords: Collaboration Skills; Creative Thinking; Project Based Learning

Introduction

One of the needs of human life that must be met is education. Education is an important element in life, because the future of a nation and country depends on how an educational institution is built and formed (Ochilova, 2020; Shaturaev, 2021). Education is an important aspect in influencing and supporting students to have the ability and skills to learn and innovate, skills to use technology and information media, and be able to work and survive by using skills for life (life skills) (Kusumaningrum et al., 2017; Martawijaya et al., 2023). In the 21st century, physics learning has 4C goals, namely: Communication, Collaboration, Critical Thinking and Problem Solving, Creativity and Innovation (Putri et al., 2021; Rudianto et al., 2022; Zulkarnain et al., 2020).

The key to success in studying physics lies in skills in achieving science (Riyadi, 2019). One of the focuses of improving education in Indonesia is improving student learning creativity (Machali et al., 2021). Creativity has become an important part of the discourse on improving the quality of learning, until now creativity has been accepted both as an inherent competency in the learning process and outcomes. The essence of creativity is to produce something better or something new (DeGraff & Lawrence, 2002). New can be meaningful as a result of perfecting, adding, changing, and repositioning

How to Cite:
Yanti, N., Rahmad, M., & Azhar. (2023). Application of PjBL (Project Based Learning) Based Physics Learning Model to Improve Collaboration Skills and Creative Thinking Ability of Students. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 9973–9978. https://doi.org/10.29303/jppipa.v9i11.5275

something that existed before so that something changes for the better. If teachers use this concept as a basis for learning development, then the quality of human resources will definitely be better. De Graff & Lawrence's opinion was reinforced by the results of Makayatun and Novitayani's research on the importance of creativity in learning that, high creativity affects the atmosphere and learning outcomes of students (Mukayatun et al., 2013; Novitayani, 2015).

One of the efforts to develop learning creativity is the Project Based Learning model (Sumarni & Kadarwati, 2020; Ummah et al., 2019). The educational base that emphasizes projects can maximize student activities in learning, can increase students' creativity, creative thinking ability and help students to develop long-term learning skills (Chen et al., 2022; Novianto et al., 2018; Suwarno et al., 2020). Project-based learning has enormous potential to make learning experiences more interesting and meaningful for students and can improve students' scientific performance in learning, while teachers only act as facilitators and mediators. Case studies conducted by also concluded that PjBL can support, facilitate, and improve the quality and process of learning, and at the same time can also enrich students' learning creativity. Other advantages of project-based learning can create a varied learning atmosphere, avoid the usual atmosphere of boredom in school, and make the learning environment more interesting, fun, exciting, and proud for students (Novianto et al., 2018; Virtue & Hinnant-Crawford, 2019).

Project-based learning has enormous potential to make learning experiences more interesting and meaningful Ningsih et al. (2020), for students and can improve students' scientific performance in learning, while teachers only act as facilitators and mediators. Case studies conducted by Tamim & Grant (2013), also concluded that PjBL can support, facilitate, and improve the quality and process of learning, and at the same time can also enrich students' learning creativity.

Based on these reasons, project-based learning needs to be applied in the process In the learning process, teaching materials in the form of modules are needed so that students can learn independently. In addition, modules can also serve as reference materials and evaluation tools for learners. The same opinion was also expressed by Heong et al. (2011) in his research which stated that using modules can be an alternative approach for students in solving student learning problems. In addition, Novitayani (2015), also found in his research that the use of modules can help the learning process in increasing student learning creativity.

Therefore, good and appropriate module packaging needs to be arranged in order to facilitate students in achieving good learning. The material covered in this module is static fluid matter. The selection of this material is based on the results of an evaluation analysis of learning outcomes in the 2013/2014 National Examination which categorizes fluid material including material that is difficult to understand with a percentage of mastery of 46% in Kampar district. This material requires concept discovery, understanding, and real application in everyday life. Static fluid is a difficult material to understand because the delivery of this material has not been done in a direct and contextual way such as making projects. In fact, in accordance with the cone of experience of Susilana & Riyana (2008) which states that learning with direct or contextual experience is the most concrete level of learning, because students are faced directly with the surrounding environment.

Method

The type of research used is classroom action research which is one of the efforts that teachers can make to improve the quality of teachers' roles and responsibilities, especially in learning management (Wijayati et al., 2019). The Classroom Action Research model used is the Suharsimi Arikunto model can be seen as Figure 1.

Project Determination, students determine the title of the product based on the project assignment shared by the teacher. Design Project Completion steps, students plan the stages of product work activities from the first to the last task work and its classification. This planning activity contains regulations for working on project tasks, determining activities that can support project tasks, combining various opportunities for working on project tasks, designing sources/materials/tools that can support project tasks, and collaboration between group members.

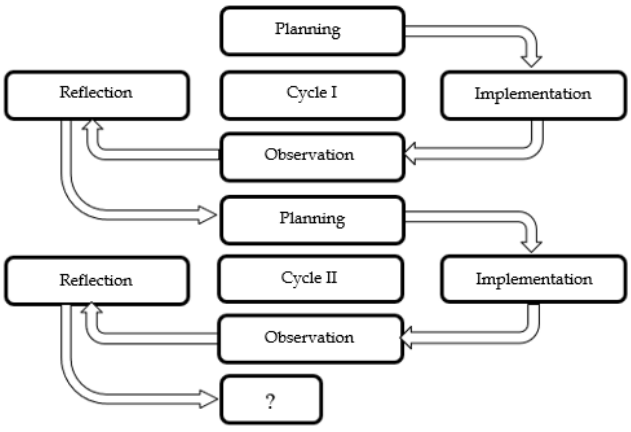

Figure 1. PTK Cycle Diagram (Arikunto, 2006).

The research conducted at SMAN 1 Kampar Timur used several ways to collect data during the research process, including.

Observation

That is, the researcher makes observations of the object and in this way the researcher will obtain data objectively because the object does not know that he is being studied. This observation sheet is prepared to determine the implementation of the Physics learning process with approved lesson plan, namely by applying a project-based learning approach.

Table 1. Skill Observation Sheet Grid Student Collaboration

Indicators	Collaboration Skills Sub Indicator
Contribute actively	Always express ideas, suggestions, or solutions in discussions.
	Ideas, suggestions or solutions expressed are useful in discussions.
Work productively	Use time efficiently by staying focused on the task without being ordered and produce the work needed.
Show flexibility	Accept joint decisions.
	Receive awards, criticisms and suggestions.
	Understand, negotiate, take into account differences to achieve problem solving, especially in multi-cultural environments.
	Flexible in working together.
	Always compromise with the team to solve problems.
Responsible and Respectful of others	Know how to plan, organize, fulfill the tasks that have been given by the teacher and hold their respective duties.
	Consistently attend group meetings on time.
	Follow orders that have become his duty.
	Not depending on others to complete their tasks.
	Respond with an open mind to differences of opinion and appreciate other people's new ideas.
	Show a polite and kind attitude to friends.
	Discuss ideas.

Source: (Rahmawati, 2019)

A test is a tool or procedure used to find out or measure something in an atmosphere, in a predetermined way and rules (Arikunto, 2004). The test used is in the form of a written question sheet in the form of an essay. Question sheets are used during the postest to determine the achievement of creative thinking skills. The preparation of posttest questions refers to indicators of creative thinking skills.

Table 2. Creative Thinking Ability Assessment Criteria

Percentage earned	Category
81 % - 100%	Very creative
61 % – 80 %	Creative
41 % – 60 %	Quite creative
21 % – 40 %	Less creative
0 % - 20 %	Not creative

Source: Modification of (Ekawati et al., 2016)

To calculate each indicator and the average creative thinking ability of students:

$$X = \frac{\sum Xi}{n} \quad (1)$$

Result and Discussion

Preparation of project implementation schedule, students with teacher guidance carry out planning of all activities that have been prepared and estimate the period of time in working on the project (Khandakar et al., 2020). Project completion with facilities and teacher monitoring, at this stage the teacher must have the responsibility to monitor the activities carried out by students in working on project assignments Yuliansyah & Ayu (2021), in monitoring activities teachers carry out assessments using rubrics that can summarize student activities in working on project assignments. Preparation of Reports and Presentations / Publications of Project Results, the final results of the project are shown to other students and teachers, shown in the form of performances in the form of learning products. Evaluation of Project Process and Results, teachers and students at the end of learning introspect on the activities and results of project tasks that have been made (Fathurrohman, 2015).

Data on students' collaboration skills were obtained through collaborative observation sheets. Observation activities are carried out at each meeting in each cycle. The following is a recapitulation of the average data

observed for each cycle.

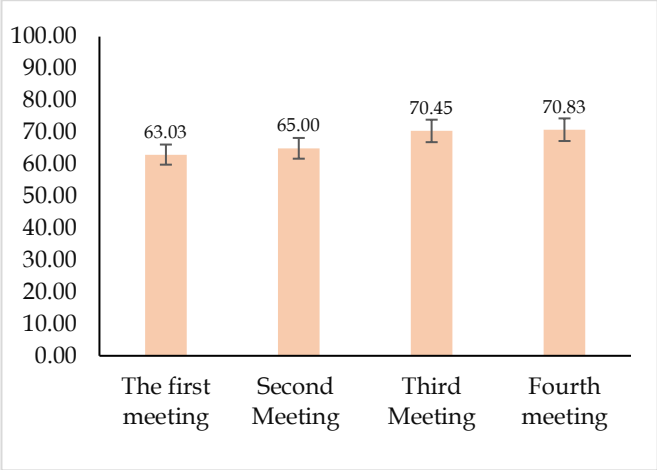

Figure 2. Recapitulation of Average Observation Results of Cycle I

Based on Figure 2 the average percentage of student collaboration, there is an increase in each meeting. In the first cycle the first meeting got an average score of 63.03 in the poor category, in the second meeting got an average score of 65.00 in the poor category, in the third meeting got an average score of 70.45 in the good enough category, and in the fourth meeting got an average score of 70.83 in the good enough category.

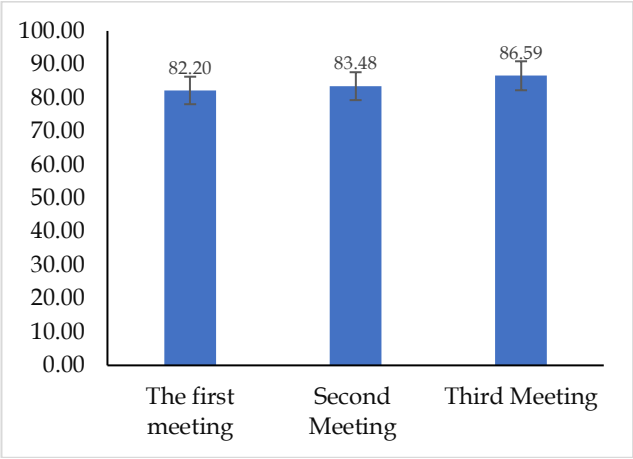

Figure 3. Recapitulation of Average Cycle II

Observation Results In the second cycle the first meeting got an average score of 82.19 in the good category, in the second meeting got an average score of 83.48 in the good category, and in the third meeting got an average score of 86.59 in the good category, this increased in the second cycle, this was because students already understood and understood the task and its role in learning. Data on students' creative thinking skills are obtained through test results. The following is a recapitulation table of the average data from students' creative ability test results each cycle.

Table 3. Creative Thinking Ability of Cycle I and Cycle II Students

Cycle	Top Rated	Lowest Value	Average
I	90.00	70.00	80.42
II	90.00	75.00	83.12

Based on Table 3 of the average test results of students' creative thinking skills, there is an increase in each cycle. In cycle I got an average score of 80.42 in the creative category and in cycle II got an average score of 83.12 in the very creative category.

In the aspect of collaboration skills, PjBL provides opportunities for students to work together in teams to solve a problem or project (Hussein, 2021; Jalinus et al., 2019). This requires students to communicate, coordinate, and share ideas to achieve common goals. In addition, PjBL also encourages students to develop social skills such as empathy, tolerance, and leadership. In the aspect of creative thinking skills, PjBL provides opportunities for students to think critically and innovatively to solve problems or produce new products. This is because PjBL requires students to think independently, analyze information, and generate new ideas. In addition, PBL also encourages students to think outside the box and not be afraid to try new things. Based on these things, it can be concluded that PjBL is an effective learning model to improve students' collaboration skills and creative thinking skills.

Conclusion

This is evident from the increase in students' collaboration skills and thinking skills in each cycle. Improved Collaboration Skills Students in the first cycle of the first meeting got an average score of 63.03 in the poor category, in the second meeting got an average score of 65.00 in the poor category, in the third meeting got an average score of 70.45 in the good enough category, and in the fourth meeting got an average score of 70.83 in the good enough category. In Cycle II the first meeting got an average score of 82.19 in the good category, in the second meeting got an average score of 83.48 in the good category, and in the third meeting got an average score of 86.59 in the good category. The ability to think creatively of students also increases in each cycle. In cycle I got an average score of 80.42 in the creative category and in cycle II got an average score of 83.12 in the very creative category.

Acknowledgments
The authors would like to express their thanks to all parties involved and supporting this research so that it can be completed.

Author Contributions
The authors i.e N.Y, M.R, and A are jointly cooperative to complete this article at each stage.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

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