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Implementation of project-based learning model to improve students' product creativity in natural sciences learning

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Abstract

Improving students' creativity is very important in 21st-century education. One form of creativity is the ability to develop a product. Based on the observation, students already had the potential for creative thinking, but they had difficulties expressing these ideas in a product. This study was conducted to determine the improvement in students' product creativity in Natural Science learning with the implementation of the Project-Based Learning (PjBL) model. The method used was classroom action research consisting of two cycles. Each cycle included three stages, namely planning, implementing, and reflecting. Data were collected through observation notes and documentation during the activities. The results of this study indicate that learning by implementing the Project-Based Learning (PjBL) model in the Natural Sciences subject can increase the creativity of students' products. It is evidenced by an increase in student creativity by 24.45 based on the product assessment from cycle I which was 64.44 and cycle II was 88.89. In cycle I, improvements were still needed, but in cycle II students were more creative in preparing tools and materials, making products neater and paying attention to color matching, and generating relatively new and unique product ideas.

Keywords: Project-based learning, product creativity, Natural Sciences, classroom action research

INTRODUCTION

Law No. 20 of 2003 related to the national education system explains that national education functions to improve the ability and shape the character of the nation's civilization that is ethical. The survival of the nation can be guaranteed by the existence of one of the main pillars, namely education (Priscilla & Yudhyarta, 2021). Education can influence the achievement of the goals of its people's lives, so it can determine whether a nation will become a nation that is left behind or an advanced civilization. Education carried out by a nation has

the aim of developing the potential of its people to become human beings who are ethical, knowledgeable, noble, creative, faithful, and devoted to God (Omeri, 2015).

The current era, the 21st century, is characterized by the progress and development of science and technology. This situation must be followed by education that can meet the demands of the times. 21st-century education is expected to produce human resources who have various forms of 21st-century skills, namely 4C skills including creative thinking, critical thinking and problem-solving, communication, and collaboration (Handajani et al., 2018). In this era, as the next nation generation, students must be able to face challenges that require new and unique solutions. One of the 21st-century skills that are important and need to be possessed by students is creativity skills (Alzoubi et al., 2016). Therefore, education units are required to prepare students to face challenges creatively and have a positive impact on individuals and society.

Creativity is one of the skills that individuals must come up with something new including ideas or thoughts that are different from others (Firdaus et al., 2018). To show their creativity, students do not have to make something new, but they can try to share ideas by making a product that is different from existing products. For example, students can combine pre-existing data and make a change as a distinction in their work (Widiastuti et al., 2020). Student creativity needs to be improved through learning activities. By practicing a lot and being stimulated through learning activities, it is expected that student creativity can increase.

One of the ways to realize students' creativity is through learning Natural Sciences (IPA). Natural science learning is essentially related to methods in the search related to nature and its symptoms systematically (Iskandar & Kusmayanti, 2018). These natural symptoms can be known by interpreting the facts and principles that exist in Natural Sciences. In Natural Science learning, students are involved in investigations related to phenomena that occur in nature so they will go through a process of discovering meaningful understanding through the experiences they have had. This shows that learning Natural Sciences require cognitive skills that aim to build conceptual frameworks and process skills so it can develop students' creativity (Agustiana et al., 2020).

The observation results indicate that students have high curiosity. It can be seen from their active involvement in asking questions if they did not understand a learning material and if the teacher asked them questions, they would be alert and compete to answer them. It proves that students have the potential to think creatively. Students who have creativity potential can be seen based on their active involvement in asking and answering questions and showing interest in learning (Karmila et al., 2021). When making a learning product, students were given the freedom to seek inspiration from various sources including books and the internet so students could express the creativity of diverse ideas. However, they found it difficult to express ideas and each group tended to make the same products. Therefore, instructions and guidance in the form of motivation and challenges are needed to help them share their creative ideas in a learning product.

Various efforts to improve students' creativity have been made by experts, namely by implementing the Project-Based Learning (PjBL) model in teaching and learning activities. (Hartono & Asiyah, 2018; Setiawan et al., 2021; Zuniarti, 2021). Project-Based Learning (PjBL) is a learning model that involves students in making a project that can be done with a

group (Zuniarti, 2021). This learning model allows students to express their reflections in the form of ideas and express their opinions on a project (Widiastuti et al., 2020). Project-Based Learning (PjBL) provides extensive opportunities for students to determine the form of the project, conduct research, and complete it.

There have been many studies on Project-Based Learning including the research conducted by A. Y. Sari & Zulfah (2017) in early childhood education which shows that PjBL can produce a product through a project that can be done individually or in groups. The result of research conducted by Zakiah et al. (2020) indicates that carrying out learning activities through PjBL in groups can improve and facilitate students to get meaningful learning optimally so they can make a product. Furthermore, Manobe & Wardani (2018) state that there is an increase in student learning creativity by using the Project Based Learning model in Natural Sciences learning.

Based on the previous research, this research is different from existing research because this research is more specific to examine more deeply the implementation of the Project-Based Learning model to improve the creativity of students' products in Natural Sciences learning where in this study students' creativity is assessed based on product planning to product development activities. Therefore, based on existing facts and conditions, it encourages researchers to conduct research that would become new findings aimed at improving learning through the implementation of the Project-Based Learning (PjBL) model to improve students' product creativity. This implementation prioritizes students' creativity in expressing their ideas through a product from the results of the learning process on the solar system material.

METHOD

This study used the Classroom Action Research (CAR) method. This CAR research used the model by Phillips & Carr (2014) with a simple cycle consisting of 3 main stages, namely: (1) Plan; (2) Implement; and (3) Reflect. Classroom action research is conducted to improve teacher performance in learning practices and their influence on student learning outcomes. During the learning activities, the implementation of the Project-Based Learning model was carried out through three stages (Sugiarni et al., 2022) involving: 1) *Plan* – planning the learning plan; 2) *Implement* – implementing learning and observation; 3) *Reflect* – reflecting and evaluating learning implementation.

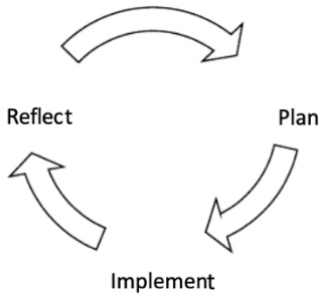

Figure 1. The Classroom Action Research Model by Phillips & Carr (2014)

This research was conducted in two cycles, namely cycle I and cycle II with a success indicator of at least 85% of students achieving an average project score of 75. This research was conducted in class 7 with a total of 31 students. The data obtained came from the project assessment of students who were given the flexibility to determine the media and product form according to students' interests and understanding. The product assessment sheet was used as an instrument to measure the level of students' creativity. Product creativity is measured based on 5 indicators, namely: 1) the preparation of tools and materials; 2) the suitability to development instructions; 3) the product suitability to the development objective; 4) the neatness and color combination fitting the concept; and 5) the original product idea (Novera, 2019).

Data collection techniques in this study were using observation and documentation. The data were analyzed using the model by Miles & Huberman (1992) including: (1) data reduction – sorting out important, relevant, and meaningful data from very general data; (2) data presentation – presenting selected data descriptively with a systematic and logical presentation flow; (3) verification and conclusion drawing – concluding the results obtained during the research. This analysis model can be described as follows:

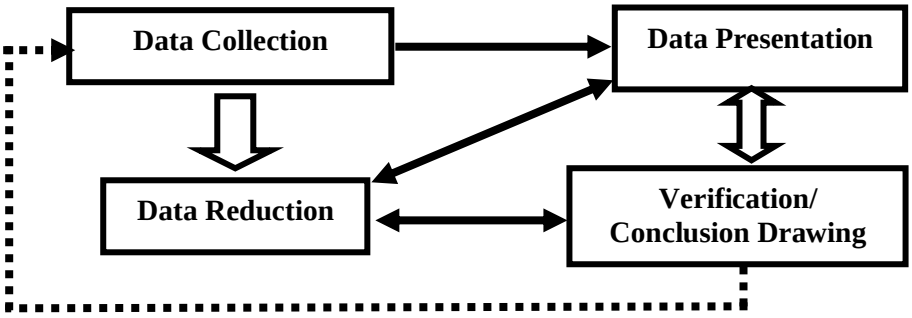

Figure 2. Data Analysis Model by Miles & Huberman (1992)

FINDINGS AND DISCUSSION

Project-Based Learning (PjBL) is a learning model that involves students in investigating real problems and gaining new and more meaningful understanding of the problem (Susilawati et al., 2017). The PjBL learning model provides students with ample opportunities to conduct research, plan, and reflect on their projects (Setiawan et al., 2021). PjBL learning activities take place collaboratively with the division of heterogeneous groups and provide opportunities for teachers to manage learning activities in the classroom that actively involve students during project activities (Rohana & Wahyudin, 2016). This shows that learning using the PjBL model can train students to plan a solution in the form of a product through project activities.

The products developed in project activities are based on students' perspectives to create better solutions to existing problems. This perspective is influenced by students' creativity (Makmur, 2015). Different points of view can stimulate the emergence of various ideas and develop the cognitive structure of students so they can produce more creative products. The creativity of students' products can be measured through product assessment which includes the preparation process and the process of product development. According to Novera (2019),

there are 5 aspects in the product assessment to measure students' creativity including 1) the preparation of tools and materials; 2) the suitability to development instructions; 3) the product suitability to the development objective; 4) the neatness and color combination fitting the concept; and 5) the original product idea.

The implementation of Project-Based Learning was conducted in two cycles. Each cycle has the same three stages, namely plan - implement - reflect. This research was conducted to determine the improvement of students' product creativity through the implementation of Project-Based Learning. The following is a description of the implementation of PjBL in each cycle.

Cycle 1

a. *Plan*

The planning stage is carried out to produce a learning implementation plan that actively involves students during the learning process. The development of the learning implementation plan was carried out by the model teacher and the mentor teacher collaboratively to produce learning steps, the media used, teaching materials, and assessment instruments. The following agreements were obtained from the planning process: (1) The learning material used the solar system material; (2) Project-Based Learning was used as the learning model; (3) The strategy used was window shopping; (4) The product that students would make was a solar system model.

b. *Implement*

At this stage, the model teacher conducted teaching and learning activities based on the plan that had been made. During the learning practice, the mentor teacher observed the learning practice. The learning stages consisted of three sequential activities which included opening, main, and closing activities. In the opening activity, the model teacher provided an apperception and explained the learning objectives to students before moving to the main material. Continuing to the main activity, the model teacher grouped students heterogeneously into 6 groups. Each group received a student worksheet (LKPD), tools, and materials that would be used in the window shopping activity.

Students did the window shopping activity related to the identification of celestial bodies in the solar system. Then the model teacher directed students to make solar system model products according to their interests and understanding. Groups that had completed the products presented the results of their discussion in front of other students, while groups that did not make a presentation paid attention and gave questions and suggestions. The model teacher provided reinforcement of the material during the presentation activities. At the end of the lesson, the model teacher and students did a reflection and the model teacher gave an evaluation in the form of a posttest.

During the main activities, the model teacher assessed students' creativity based on product planning to product product-making activities. The following are the assessment recapitulation results of students' product creativity.

Table 1. Recapitulation of Data from Cycle I Product Creativity Assessment Results

No	Aspect	Score	Description
1	The preparation of tools and materials	55.56	Failed
2	The suitability to development instructions	83.33	Passed
3	The product's suitability to the development objective	94.44	Passed
4	The neatness and color combination fitting the concept	50.00	Failed
5	The original product idea	38.89	Failed
	Total	322.22	
	Average	**64.44**	Failed

Table 1 presents the recapitulation of product creativity assessment result in Cycle I. The data show that students did not pass the passing grade in three aspects of creativity, namely the preparation of tools and materials, the neatness and color combination fitting the concept, and the original product idea.

c. *Reflect*

Reflection activities were carried out with observers, namely the model teacher and the mentor teacher. The reflection results showed that the learning had been carried out in accordance with the lesson plan and students were actively involved during learning, especially during window shopping and product-making activities. However, the model teacher experienced obstacles in conditioning students when working on assignments. In addition, when developing products, there were groups that were lacking in bringing the tools and materials needed.

Table 2. Reflection Results of Students' Product Creativity in Cycle I

No	Aspect	Obstacle	Solution
1	The preparation of tools and materials	There were groups of students who lacked materials and did not bring tools when developing products.	Reminding students about tools and materials that they must bring through the class WhatsApp group
2	The neatness and color combination fitting the concept	The final product developed had a color that did not match the color of the planet.	Visiting each group to monitor the product developed in accordance with the material concept
3	The original product idea	Products made by 5 groups were made of plasticine and had the same idea of product form.	Providing instructions and guidance to each group to develop a product based on their interests and understanding

Table 2 shows the results of cycle I reflection on students' product creativity. In this reflection activity, solutions to the obstacles resulting in students' failure in three aspects of creativity were determined.

Cycle II

a. *Plan*

The process of planning cycle II was organized by considering the results of joint reflection in cycle I. The agreements resulted from planning activities included: (1) The material used in cycle II learning was the earth and its satellites; (2) The product that would be developed by students was a lunar eclipse model; (3) The teacher could convey class agreements at the beginning of learning to condition students; (4) The teacher provided instructions and guidance to each group so the form of the product chosen was in accordance with their interests and the products produced were more varied; (5) The teacher visited each group during product making to check the suitability of the product with the concept of the material; and (6) Before the day of product development, the teacher reminded students to prepare the tools and materials they needed.

b. *Implement*

This stage is the implementation of cycle II planning that had been arranged in the lesson plan, namely the implementation of learning in the classroom in accordance with the previously agreed plan. The mentor teacher as an observer made observation during the learning process, while the model teacher carried out learning practices using the same strategies and methods as cycle 1. In the opening activity, the model teacher made a class agreement regarding the time for working on group assignments. Before doing this activity, the model teacher provided a different material content to each group that would be used as a material for the window shopping activity.

In product planning activities, the teacher visited each group to find out the obstacles faced and provided reinforcement of concepts. In addition, the teacher also guided each group in developing products according to students' interests and understanding. This is done to bring up different ideas or ideas for each group. Moving to the end of learning, the model teacher gave a posttest as a learning evaluation and distributed learning reflection sheets to be filled in by students. During the main activities, the model teacher observed and assessed the stages of developing products done by students. This aimed to determine the level of creativity of students' products. The results of this assessment are shown in Table 3.

Table 3. Recapitulation of Data from Cycle I Product Creativity Assessment Results

No	Aspect	Score	Description
1	Preparation of tools and materials	83.33	Passed
2	The suitability to development instructions	94.44	Passed
3	The product's suitability to the development objective	100.00	Passed
4	The neatness and color combination fitting the concept	83.33	Passed
5	The original product idea	83.33	Passed
	Total	444.44	
	Average	**88.89**	Passed

Table 3 describes the recapitulation of product creativity assessment result in Cycle II. The data show that students passed the passing grade in all creativity aspects and the average score improved.

c. *Reflect*

The reflection stage was carried out collaboratively between the model teacher and the mentor teacher regarding the learning practices that had been carried out in cycle II. The reflection results indicated that the learning activities had been carried out in accordance with the initial planning in the lesson plan made by the teacher. The teacher had also actively involved students during learning activities. It could be seen during product developing activities when each group cooperated and students had prepared all the tools and materials needed. The products developed were more varied in the form of 3D models, infographics, scrapbooks, and pop-up books.

In the creativity aspect of preparing tools and materials, there was an increase in scores from cycle I to cycle II of 27.78. This shows that students have thought fluently in expressing their ideas related to determining what tools and materials are possible to realize their various ideas. This aspect is closely related to the fluency aspect of creative thinking. Fluency is students' skill in expressing various ideas about a problem (I. Y. Sari & Manurung, 2021). In the aspect of creativity of the suitability to the development instructions, the scores obtained in cycle I and cycle II were in the "passed" category and experienced an increase. In cycle I, students could develop products that were in accordance with the development instructions, but there were some students who did it not in sequence. In cycle II, students had been able to determine the steps of developing products sequentially and flexibly according to the materials and tools they had determined. Flexibility in product creativity allows students to generate ideas from different perspectives, in this case, it is related to the idea of the stages in developing the product. (Amtiningsih et al., 2016).

In the aspect of product creativity regarding the product suitability to the development objective, students can produce products that are in accordance with the function of developing the product. This aspect has the highest score in both cycle I and II and there is an increase in score from cycle I to cycle II, which is 5.56. This can happen because the teacher guided students in utilizing devices and internet networks to find various sources of information to find suitable product ideas. Students could make products in the form of a solar system model that could be used to ease them in understanding the material. The product has contained the main criteria of the concept of solar system material. Students have been able to develop products that are suitable for use because they are in accordance with the criteria and functions of the product's development (Novera, 2019).

The creativity aspect of neatness and color matching is closely related to students' elaboration skills. Elaboration relates to the skills that students have in transforming ideas and combining them to form an elaborated and detailed product (Trianggono & Yuanita, 2018). In cycle I, students got a score of 50.00. It was because students had not fully understood the material concept, so the product development was not in accordance with the colors of planets that have special characteristics. However, in cycle II, students had

passed this aspect. Students had made the product neatly and the color combination fitted the concept of the material taught.

The creativity aspect of the original idea involves students' ability to produce a variety of ideas or ideas that are relatively new, unique, and different from others based on the problem domain (Vendiktama et al., 2016). In cycle I, the score obtained by students was 38.89. This shows that the ideas raised by students are still the same as others. On the Other hand, in cycle II, the score on the originality of the idea increased to 83.33. Students had been able to come up with new ideas that were different from each other. This is influenced by the role of the teacher as a facilitator who guided students in question-and-answer activities and discussions by providing driving questions and feedback so students can further develop aspects of fluency and flexibility to make it easier for the teacher to bring up students' unique ideas and thoughts (Amtiningsih et al., 2016).

The scores of students' product creativity during the two cycles increased by 24.45. This shows that implementing PjBL model can increase students' creativity in developing products. This is in line with the research by Zuniarti (2021) and Rohana (2016) which shows that students' creativity and skills in developing products can increase after the implementation of Project-Based Learning. According to Condliffe et al. (2017), PjBL can be used to improve creativity, thinking skills, and collaborative skills. In addition, PjBL learning can allow students to explore materials in a variety of diverse ways to construct their knowledge through collaborative activities (Hartono & Asiyah, 2018).

CONCLUSION

Based on the research data, it can be concluded that there is an increase in learner creativity based on product assessment from cycle I to cycle II by 24.45. In cycle I, students had not yet reached the passing grade for product creativity in three aspects, namely: 1) the preparation of tools and materials; 2) the neatness and color combination fitting the concept; and 3) the original product idea. However, in cycle II learning, students had reached the passing grade in all aspects. Thus, it can be said that learning by applying the Project-Based Learning (PjBL) model in Natural Sciences subject can increase the creativity of students' products.

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