TEM Journal. Volume 13, Issue 1, pages 581-589, ISSN 2217-8309, DOI: 10.18421/TEM131-61, February 2024.

Innovative Learning Strategies: Project-Based Learning Model for Excelling in Visual Programming

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Abstract **– Modern education demands innovative approaches to engage students effectively and enhance learning outcomes. This article explores the implementation of an innovative pedagogical approach, namely Project-Based Learning (PjBL), in the context of the Visual Programming course. The study aims to investigate the impact of this approach on students' participation and learning achievements. Using a Classroom Action Research (CAR) design, the research was conducted in two cycles. The participants were 30 students enrolled in the Educational Technology Informatics program at Universitas Negeri Padang. The study used a descriptive comparative method to assess the outcomes, comparing pre-cycle to Cycle II results. The findings reveal remarkable improvements in student's cognitive growth (53.33%), affective development (46.66%), and psychomotor skills (56.66%) following the application of the PjBL approach. Furthermore, there was a noticeable increase of 43.44% in the active participation of students during the learning process after incorporating the PjBL approach.**

In conclusion, this study underscores the effectiveness of PjBL in fostering active participation and elevating learning achievements in the Visual Programming course. The article contributes to the discourse on innovative pedagogical strategies. It highlights the potential of PjBL to revolutionize traditional educational methods, equipping students with skills engagingly and effectively.

Keywords **– Innovative learning strategies, project-based learning (PjBL), visual programming, educational technology.**

DOI: 10.18421/TEM131-61
https://doi.org/10.18421/TEM131-61

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Received: 29 September 2023.
Revised: 29 December 2023.
Accepted: 09 January 2024.
Published: 27 February 2024.

1. Introduction

Recent technological advancements have transformed education [1], [2]. The integration of cutting-edge technologies such as AI, microlearning, augmented reality, virtual reality, gamification, blockchain, and mobile learning is reshaping the educational landscape, ushering in an era of interactive and personalized learning experiences [3], [4]. This shift extends beyond technology to embrace changes in teaching methodologies, moving from a traditional teacher-centered approach to a more student-centered learning model [5]. The success of this transformation is evident in enhancing students' cognitive, emotional, and psychomotor abilities through innovative digital tools and platforms [6], [7].

A key indicator of successful learning is the structural transformation that signifies the correct and effective implementation of the learning process. The quality of classroom learning significantly influences student learning outcomes. Achieving superior learning standards necessitates collaboration across all educational elements, encompassing learning objectives, the roles of teachers and students, learning materials, teaching approaches, techniques, resources, and the evaluation of the teaching-learning process.

Additionally, factors like the application of learning models aligned with learning characteristics, as discussed by Batubara [8], play a crucial role in educational success.

A learning model represents a cohesive sequence of methods, strategies, and conceptualizations the teacher employs throughout the lesson [9]. The use of appropriate learning models can significantly improve the effectiveness and efficiency of the teaching-learning process. Furthermore, the choice of the teacher's instructional method not only enhances student engagement but also contributes to more effective and enjoyable learning experiences [10].

However, conventional learning models are still often applied in the context of visual programming learning, which aims to develop the ability to understand, analyze, and program design [11]. This approach causes the lecturer to play a dominant role as a transmitter of information. In contrast, as recipients of information, students have a passive role and tend to hinder the development of their critical thinking skills. The use of monotonous conventional models can also reduce the level of student involvement in learning. This condition causes inactivity, boredom, and a lack of motivation in learning.

In addition, the conventional learning model is not based on the curriculum objectives that have been prepared based on the Minister of Education and Culture Regulation No. 3 of 2020, as well as with the concept of Merdeka Belajar, Kampus Merdeka (MBKM), which aims to improve graduate competence. Therefore, a new approach is needed to enhance graduates' competence. One of the solutions that can be implemented to support and enhance graduate competence is to apply a project-based learning model known as PjBL.

PjBL is a learning model that regulates the learning process through projects or main assignments [14], [15]. According to Jalinus *et al.* [16], PjBL is a learning strategy in which students actively build their understanding of learning material and express new knowledge through various forms of representation. Jhon Larmer [16] describes PjBL as a dynamic approach to learning in which students actively explore real-world issues, face challenges, and gain a deeper understanding. In general, PjBL can be interpreted as a learning model that places students at the center of learning. In this approach, students design and apply learning concepts through the completion of a final project, which involves exploring and solving real-world problems independently.

A comprehensive evaluation in PjBL involves an assessment of the attitudes, knowledge, and skills students acquire throughout their study journey [17].

The project appraisal process involves evaluating the tasks to be completed within a specific timeframe [18]. These tasks cover various stages, such as planning, gathering, organizing, executing, and presenting information for the assessment process. Project evaluation has a role in measuring understanding, applying skills, investigative abilities, and clear communication skills related to certain concepts students learn.

Nonetheless, each learning approach has its advantages and limitations. In the context of PjBL learning, this approach is designed with the aim that students can overcome challenges through involvement in project activities. Students can gain real-world experience related to project planning by participating in projects. At every step of the activity, students will have first-hand experiences that can increase their creativity and learning outcomes [19], [20].

The PjBL method can support students in developing the latest concepts and gaining new experiences to increase their learning outcomes and creativity in solving problems and creating products. As explained, several aspects have been described regarding the development of creativity in children, one of which is through facilitation. In this context, efforts are made to facilitate students' ability to imagine products and solutions to the problems they face [21], [22].

In addition, the lecturer's role also includes providing stimulation so that student creativity can develop through data obtained during activities, including experiments and elaborations. Doing so makes learning more meaningful, making students more likely to remember it. Therefore, the implementation of the PjBL model is needed to provide a different learning experience for students, ultimately improving their abilities and skills, understanding, analysis, and visual program design.

Previously, in 2022, a study was conducted by Saad [23], which aimed to improve student performance and achievement by applying the PjBL. In this study, data analysis was performed, paying attention to student performance and achievement measured by pre-test scores, product assessments, and post-test scores.

Meanwhile, the described research focuses on identifying improvements in student learning outcomes in visual programming courses. This research includes cognitive, affective, and psychomotor aspects and the level of student activity during the learning process.

2. Methodology

This study is a form of Classroom Action Research carried out in a classroom environment as a step in overcoming the challenges faced by lecturers during the teaching and learning process, focusing on improving the quality and results of student learning. This research aims to implement various learning methods and strategies with high effectiveness. The approach used in the framework of this research follows a four-stage step model [24], which involves the process of planning, implementing, observing, and reflecting.

This research was conducted in two cycles, each consisting of three meetings. Gradual increases occur in each meeting of Cycles I and II. At the initial meeting, students were asked to find information about the material to be taught. At the second meeting, students focused on projects related to this material. Meanwhile, at the third meeting, the learning process results were assessed.

The data analysis technique applied in this study is a comparative descriptive statistical technique. This technique involves comparing the results of descriptive statistical calculations, such as the percentage of successful learning outcomes between one cycle and the next.

This study's performance indicators included the success rate of learning outcomes and the level of student engagement, with a minimum score set at 76%. The research involved 30 students from the Informatics Engineering Education Study Program at Universitas Negeri Padang during the 2022 semester.

Students are considered successful if the value of learning outcomes in the cognitive, affective, and psychomotor aspects has achieved a minimum success score, namely 68 for the cognitive and psychomotor aspects and 75 for the affective aspect. The minimum criterion for success for the level of student activity is 75.

3. Results

The results showed an expected increase from cycle I to cycle II thanks to the application of the PjBL model. In each learning cycle, in the end, students are asked to work on assessment questions that measure learning outcomes in visual programming courses based on cognitive, affective, and psychomotor aspects and the level of student activity during the learning process.

Below is a comparison of student learning outcomes in the visual programming course from before the cycle begins to the end of cycle II. As seen in Table 1 below, there has been an increase in learning outcomes, especially in the cognitive aspect.

Table 1. The level of cognitive achievement

Achievement of Cognitive Outcomes	Pre-Cycle	Cycle I	Cycle II
Students who achieve success (score ≥ 75)	11.00	18.00	27.00
Students who do not achieve success (score < 75)	19.00	12.00	3.00
Success Percentage (%)	36.67	60.00	90.00

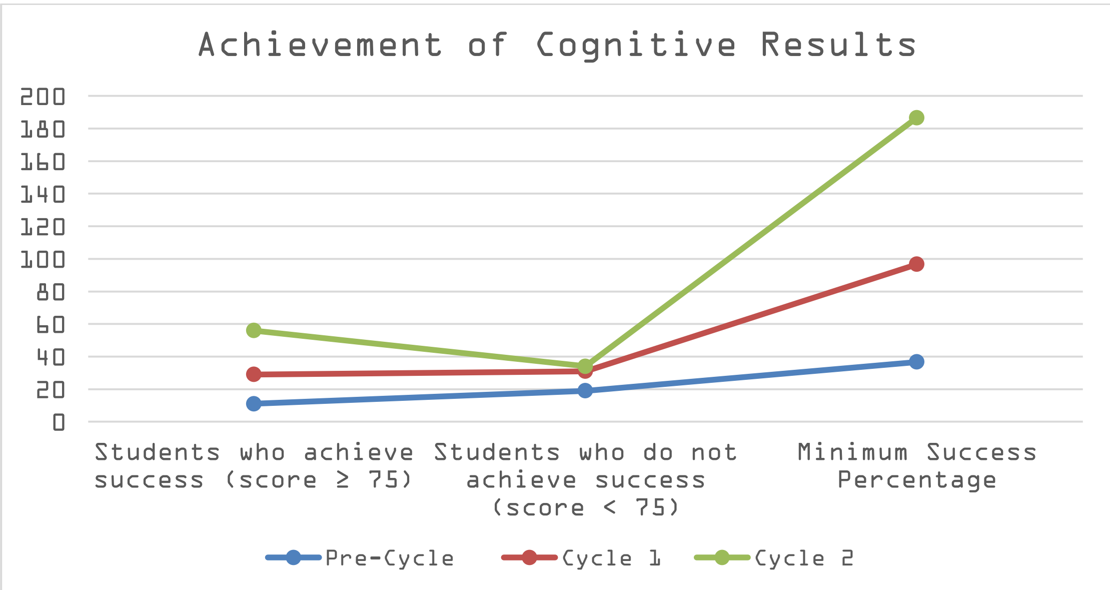

Figure 1. The level of achievement of cognitive results

From the data, it can be concluded that there was a significant increase in cognitive learning outcomes during the pre-cycle, cycle I, and cycle II. Before the intervention, the percentage of successful cognitive learning outcomes in the visual programming course was only 36.67%. After implementing the PjBL model in cycle I, there was an increase to 23.33%, so the percentage of students' cognitive learning outcomes reached 60%. Even though the minimum target of 76% had yet to be reached in cycle I, cognitive learning outcomes had experienced significant improvements.

Increasing cognitive learning outcomes in visual programming courses continues in cycle II by applying the PjBL model. The percentage of successful learning outcomes reaches 90%, indicating a significant increase in cognitive terms.

Therefore, these results confirm that applying the PjBL model effectively improves student learning outcomes in cognitive aspects in the visual programming course.

Next, the development of learning outcomes is also assessed from an affective perspective. Details about improving affective learning outcomes are presented in Table 2.

Table 2. The level of affective achievement

Achievement of Affective Outcomes	Pre-Cycle	Cycle I	Cycle II
Students who achieve success (score ≥ 75)	14.00	22.00	28.00
Students who have not achieved success (score < 75)	16.00	8.00	2.00
Success percentage (%)	46.67	73.33	93.33

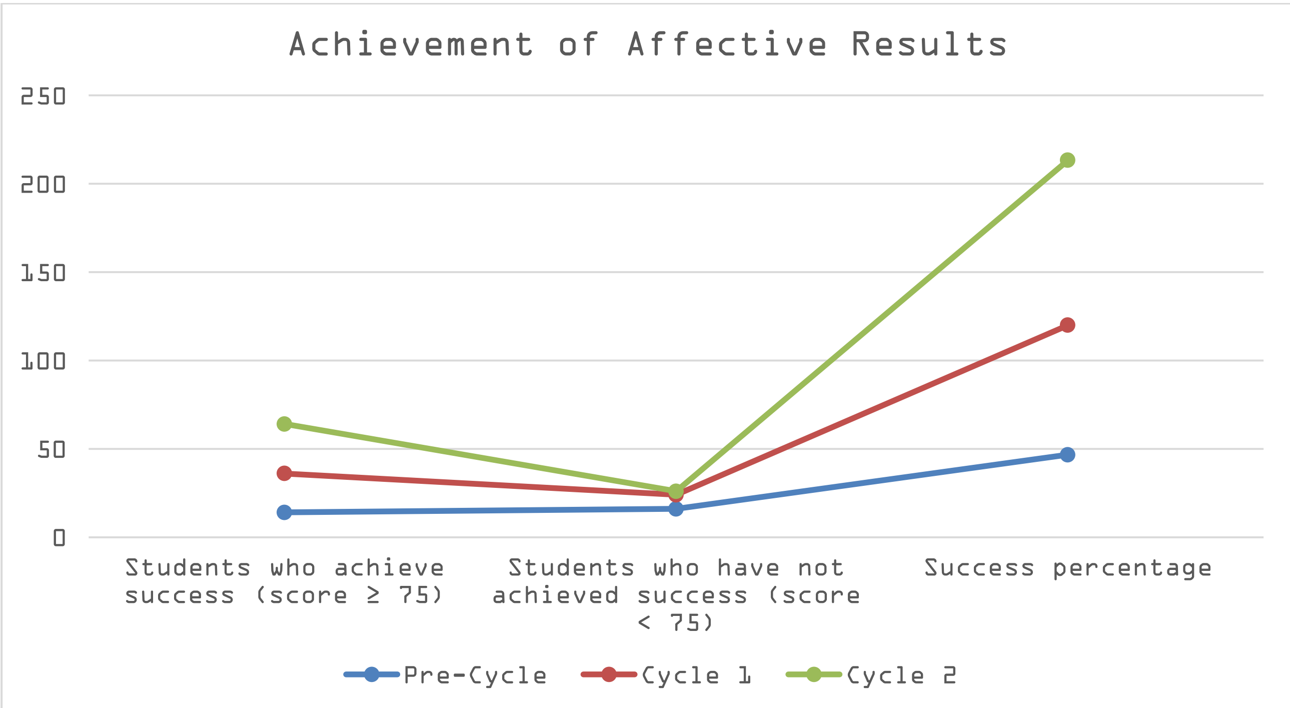

Figure 2. The level of achievement of affective results

Based on the information provided in the table and Figure 2 above, it can be concluded that there was a significant increase in affective learning outcomes in the pre-cycle, cycle I, and cycle II stages. Before the intervention (pre-cycle), the percentage of success in affective learning outcomes in the visual programming course was 46.67%. After the action was implemented in cycle I with the application of the PjBL model, there was an increase of 26.67%.

This resulted in the percentage of successful student affective learning outcomes increasing to 73.33% in cycle I. Although cycle I still had not reached the minimum target of 76%, affective learning outcomes had experienced significant improvements.

Improving affective learning outcomes continues in cycle II by applying the PjBL model. The percentage of successful learning outcomes reached 93.33%, indicating a significant increase in terms of affective.

Therefore, these findings confirm that effectively applying the PjBL model can improve student learning outcomes in the affective aspect of the visual programming course.

The findings from this study have important implications, namely that the PjBL model provides in-depth, detailed, and challenging learning experiences over a more extended period. It aims to achieve project results that create satisfying student products or work.

The following assessment is evaluated from the point of view of the psychomotor aspect. The psychomotor aspect is the ability to carry out expertise or skills after student's experience learning experiences.

Details regarding the learning outcomes of the psychomotor aspect can be found in Table 3 below.

Table 3. The level of psychomotor achievement

Achievement of Psychomotor Outcomes	Pre-Cycle	Cycle I	Cycle II
Students who achieve success (score ≥ 75)	8.00	17.00	25.00
Students who have not achieved success (score < 75)	22.00	13.00	5.00
Success percentage (%)	26.67	56.67	83.33

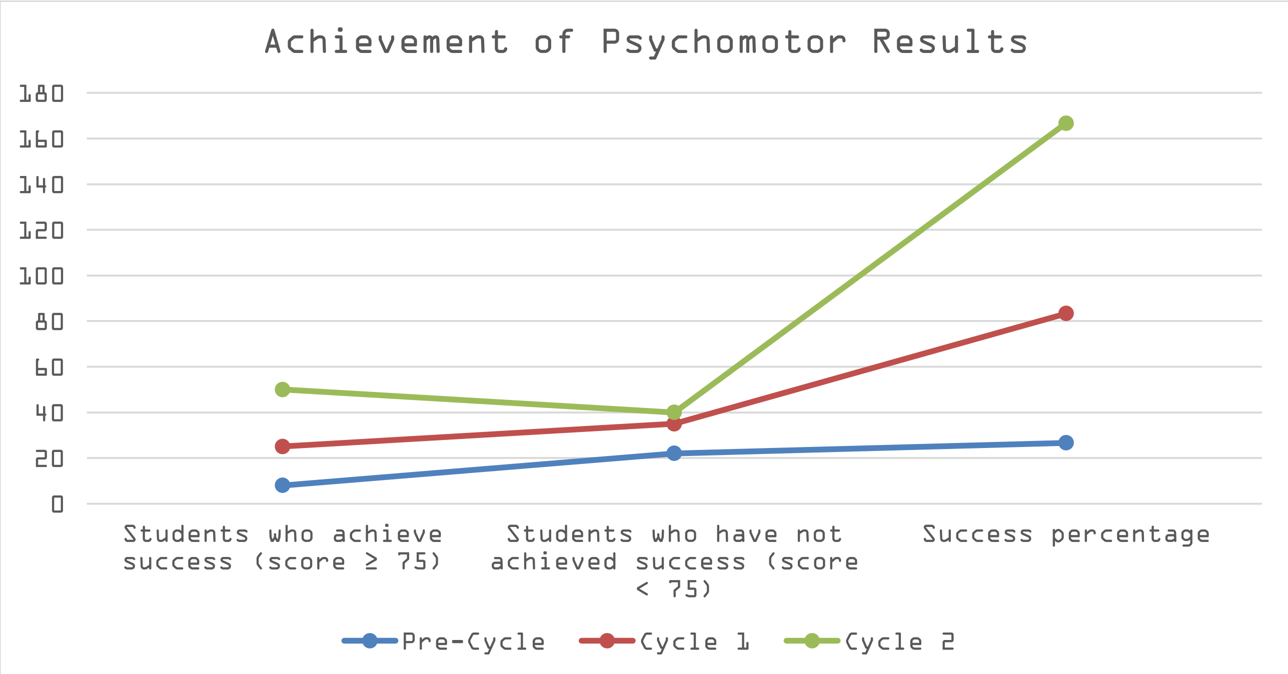

Figure 3. The level of achievement of psychomotor results

From Table 3 and Figure 3 above, it can be seen that there was a significant increase in the learning outcomes of the psychomotor aspect in the pre-cycle, cycle I, and cycle II stages. Before the intervention (pre-cycle), the percentage of successful psychomotor learning outcomes in the visual programming course was only 26.67%. This figure is far from the expected target.

After the action was implemented in cycle I by applying the PjBL model, there was a very striking increase, namely 30%. This resulted in the percentage of success in the psychomotor aspects of student learning outcomes increasing to 56.67% in cycle I. Although cycle I still had not reached the target of at least 76%, the learning outcomes in the psychomotor aspects had experienced a significant increase.

The increase in psychomotor aspects of learning outcomes continues in cycle II by applying the PjBL model.

The percentage of success in learning outcomes reached 83.33% in cycle II of the visual programming course. This proves that using the PjBL model has increased student learning outcomes in the psychomotor aspect.

In addition to the aspects described above, in implementing the PjBL model, students' active participation in visual programming learning is also considered—the results of observations regarding the level of student activity during the implementation of the PjBL model.

Student involvement while attending visual programming lectures by applying the PjBL model shows an increase that can be seen from the data presented in Table 4 and Figure 4. At the pre-cycle stage, based on observations, the percentage of student involvement was 46.67%, with only 14 students (or fourteen students) who achieved an engagement rate above 75%.

However, in the application of the PjBL model in cycle I, there was an increase in the value of student engagement, with the percentage of involvement reaching 73.33%. Even though this increase has yet to reach the target of at least 76%, this step shows a positive development.

Student involvement continues to increase in cycle II, with a success rate of 90% after implementing the PjBL model. This indicates that the PjBL model has effectively increased student involvement in the Informatics Engineering Education Study Program at Universitas Negeri Padang.

Table *4. Observation results: the level of activity*

Achievement of Activeness Level	Pre-Cycle	Cycle I	Cycle II
Active student (score ≥ 75)	14.00	22.00	27.00
Students who are not yet active (score < 75)	16.00	8.00	3.00
Success percentage (%)	46,67	73,33	90.00

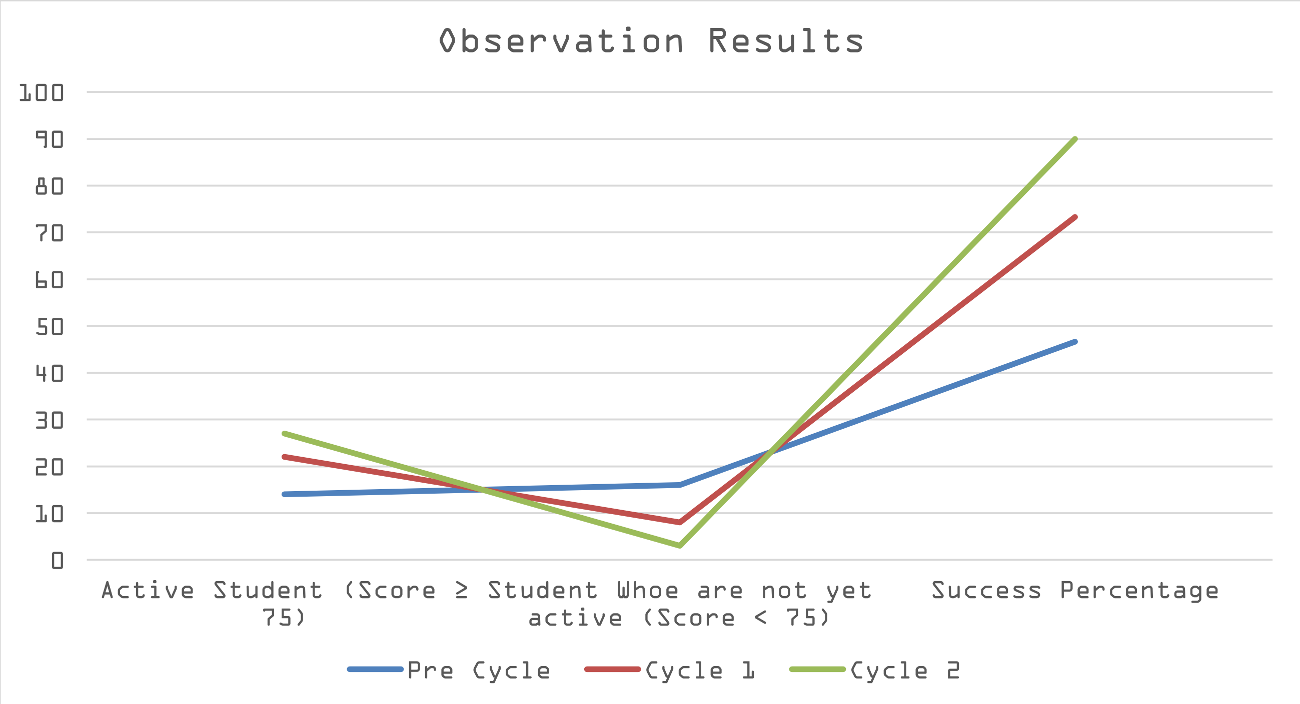

Figure 4. Observation results: the level of activity

4. Discussion

This research was carried out on students enrolled in visual programming courses. The goal is to apply the PjBL to increase cognitive, affective, and psychomotor learning achievement. Comparison between the results of cycle I and cycle II provides an overview of the increase in learning achievement. In the cycle I stage, there has been an increase in learning outcomes after the intervention was carried out, as reflected in the evaluation conducted by the researcher.

At the initial learning stage, it can be seen that student activity began to increase, their enthusiasm for attending lectures was also boosted, and they were active in discussing the production process of the products to be produced.

However, in cycle I, there were several obstacles, especially in the case of several students disturbing the class while working on projects, resulting in the situation becoming out of control. Therefore, it can be concluded that there are still areas for improvement in implementing the learning process.

Sessions I, II, and III in cycle II were considered very good, especially regarding learning activities and outcomes. The growth of learning activities and results in cycle II reached a performance indicator of 76%. Student involvement looks very good, as seen by how they listen to material explanations and are increasingly confident in asking and answering questions. In making products, students show high enthusiasm in discussing with group members, designing the necessary components, sharing tasks with fellow group members, and showing off the results of their team's work.

Students who lead homework also participate actively and can explain answers fluently, which can be understood by other groups. To create a comfortable learning environment during the product manufacturing process, researchers show special attention to certain groups, ensuring that the learning process runs positively.

The PjBL learning model positively impacts the learning process by allowing students to explore the material more deeply. This model is designed to involve students in project development and group formation, where students are directly involved in making products. This model's advantages include facilitating social interaction because students can discuss, share views, and create products through group work [21].

Not only through direct discussion and practice in making products, the PjBL model also provides students with valuable experience [25]. Students can learn from written reference sources and interactions with classmates or experts in relevant fields in this context. In addition, they can utilize various resources such as videos, micro-content, gamification, presentations, group collaborations, and the Internet to gain broader and deeper knowledge [26].

The PjBL model enables students to learn actively, collaborate, and practice knowledge in a more real environment. This leads to a better understanding and develops the social and practical skills needed in the real world [29].

From the above findings, it can be concluded that the PjBL learning model has a positive impact on increasing student learning activities and outcomes in various aspects, including cognitive, affective, and psychomotor. This aligns with the view expressed by Kuswandi *et al*. [30] that the PjBL learning model involves students in real problems according to their interests and concerns and encourages thinking skills, creativity, and participation in learning, ultimately increasing their motivation and curiosity.

Other research by Jalinus *et al.* [31] supports these findings that the PjBL model can increase student motivation and learning outcomes. Other studies have also concluded that applying PjBL supports student creativity, generating and applying new ideas in solving problems [32], [28].

In the context of science subjects, Astuti *et al.* [27] found that the STEM-integrated PjBL model was able to improve students' understanding of concepts in learning materials. Other research shows that PjBL can also enhance students' critical thinking skills, as in using this model in learning the Integrated Science of Water Pollution [13].

Overall, using the PjBL learning model provides meaningful experiences for students, enables them to understand concepts, and solve problems through projects, and encourages critical and creative thinking [12]. This approach allows lecturers to understand better the material the teacher teaches and improve their academic achievement.

5. Conclusion

From the results of this study, it is concretely proven that lecturers' application of the PjBL model in the learning process has a positive impact. Students can better understand the learning material and develop skills to increase engagement and learning outcomes. Implementing the PjBL model also assists students in completing assignments more smoothly and efficiently.

In addition, applying the PjBL model has also succeeded in changing the character of visual programming courses, making them more attractive and in line with the needs of the field of study. Using this approach, material that students may initially consider complex or abstract becomes more real and connected to real-world situations. Visual programming concepts become more relevant when applied to practical projects, which helps increase student interest and motivation in learning.

Overall, these findings suggest that the PjBL approach has significant potential in improving the quality of learning. By integrating projects into the learning process, students develop better understanding, collaboration, problem-solving, and time management skills that are important in academic and professional settings.

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