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THE EFFECTIVENESS OF LEARNING THROUGH IMPLEMENTATION OF PROJECT BASED LEARNING (PJBL): REVIEW OF STUDENT LEARNING OUTCOMES, SKILLS AND ATTITUDES

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Abstract

Project Based Learning (PjBL) is a learning model with an inquiry approach that adopts student-centered learning. This research was apre-experimental quantitative research with a one group pretest-posttest design which aims to analyze the effectiveness of learning through the implementation of PjBL. This research involved a class of students at a Junior High School in South Sulawei Province. Data collection included: 1) the test consists of 5 essay questions with cognitive level C5; 2) an attitude assessment observation sheet that measures the attitude of mutual cooperation, critical reasoning, conscientiousness and responsibility; 3) skills assessment sheet that measures the ability to observe, ask questions, explore, process data and communicate; 4) project assessment sheet, measuring the project implementation stage, results stage, and presentation stage. The data analysis technique used descriptive analysis and inferential analysis using paired-sample t-test with Shapiro Wilk normality test requirements. The research results concluded that PJBL is effectively implemented to improve the quality of research processes and results. The effectiveness indicators are described as follows: 1) Learning outcomes after implementing PjBL reach the very high category, there is a significant difference between the Pre-test and post test, the average student learning outcomes after implementing PjBL are higher than student learning outcomes before the action; 2) a series of learning activities carried out by students in PjBL such as observing skills, asking questions, exploring, processing data, and communicating are able to empower students' skills so that students' skills meet the very good category; and 3) students' attitudes in the learning process which include mutual cooperation, critical reasoning, thoroughness and responsibility meet the very good category.

Keywords: project based learning (PjBL); learning effectiveness; learning outcomes, skills and attitudes

1. Introduction

Advances in technology and science have caused various changes in society, education, the economy, and the business world. To keep up with changing times and current competitive conditions, graduates must have lifelong learning skills, generating new knowledge, self-development, managing data and information, as well as solving complex problems (Karaca-Atik et al., 2023). 21st Century workforce users also need graduates who have soft skills which include responsibility, self-confidence, social communication skills, team work abilities, hard work attitudes, self-motivation and self-management (Musa et al., 2011).

There are three categories of skills needed in the 21st Century, namely: 1) learning and innovation skills, which include creativity, innovation, critical thinking, problem solving, communication and collaboration; 2) information, media and technology skills, which include information literacy, media literacy and information and communication technology literacy; and 3) life and career skills, which include flexibility, adaptability, initiative and self-direction, social and cross-cultural skills; productivity and accountability, leadership and responsibility (Borrowski, 2019). These skills are considered capable of helping students successfully integrate into life and the world of work after graduating from school (Lauder and Mayhew, 2020), these skills are also expected to help develop a sustainable career in the long-term (Habets et al., 2020).

Considering the importance of 21st Century skills, students must be equipped with these skills starting from elementary school level. However, based on data in schools, various problems were found that showed problems such as students' low interest in learning mathematics (Fatimah et al., 2021; Putra, Mudiono and Utama, 2022); low student learning motivation (Melinda and Eta, 2020; Naibaho, Siregar and Elindra, 2021); low student activity in the learning process, learning is only dominated by certain students (Sagala, 2020); low problem-solving abilities of students (Suryani, Jufri and Putri, 2020; Eris and Rostina, 2021), and students have limited abilities in terms of flexible mathematical creative thinking (Nufus et al., 2024).

The various problems faced by students in the learning process cannot be allowed to continue, so solutions need to be provided to improve the quality of the learning process and outcomes. One learning model that can improve students' problem-solving abilities, skills and soft skills is learning with an inquiry approach. Learning with an inquiry approach is an approach to improving and transforming the quality and effectiveness of learning experiences by adopting a student-centered approach and giving students more space and time (Costes-Onishi and Kwek, 2023). The learning process with an inquiry approach further develops high-level thinking skills, which naturally begins with the creation of relevant questions or problem scenarios (Blessinger and Carfora, 2014).

Project Based Learning or abbreviated as PjBL is a learning model that applies an inquiry approach that involves students in knowledge construction by asking them to complete meaningful projects and develop real world products (Barron and Darling-Hammond, 2010; Brundiers and Wiek, 2013). In its implementation, PjBL gives students the opportunity to make a product because of a series of learning processes so that they are independent and sensitive to objects around them (Rochmawati, Wiyanto and Ridlo, 2019).

PjBL involves students in an organized, cooperative manner to investigate and solve certain problems, individual or group activities that take place over a certain period of time, producing a product, performance presentation (Musa et al., 2011). PjBL begins with an assignment that leads to the final product with the syntax (1) Asking questions related to the surrounding environment, (2) Designing the stages of project completion, (3) Developing a project implementation schedule, (4) Collecting, organizing, analyzing and interpreting data, (5) Preparation of project reports and presentations, and (6) Evaluation of project processes and results (Muskania and

Wilujeng, 2017). Implementation of the PjBL model is carried out in the following steps: 1) Determining basic questions, in this step the teacher provides problems surrounding concrete objects, including providing several objects that are relevant to the material; 2) Develop a project design, in this step, the teacher creates groups consisting of 4 people. 3) Developing a schedule, in this step, students create a project; 4) Monitoring student progress in the project, in this activity, the teacher collects information from each group during the project creation activity whether there are obstacles in this activity or no obstacles and provides solutions to each obstacle. 5) Testing the results, in this step students make group presentations; and 6) Evaluation of experience, in this step concluding the material that has been studied. Teachers and students carry out this stage at the end of learning (Fauzia and Kelana, 2020).

Krajcik, J. S., & Shin, N. (2014) show six advantages of PjBL, namely fundamental questions as a driving force, focus on learning objectives, participation in learning activities, collaboration between students, use of scaffolding technology, and creation of real work. Various previous studies also found the advantages of implementing PjBL, such as Kuppuswamy and Mhakure (2020) who found that there was a strong relationship between implementing PjBL in developing students' knowledge and skills; PjBL facilitates student growth in acquiring skills and soft skills (Musa et al., 2011); PjBL can be categorized as a learning model that can improve student learning outcomes and train students in solving problems (Nurhidayah, Wibowo and Astra, 2021); PjBL is able to improve critical thinking skills, increase learning motivation, and increase students' interest in learning (Yanti and Novaliyosi, 2023); PjBL is significantly feasible to apply in STEM education to increase learning effectiveness (Diana and Sukma, 2021); and that increasing mathematical abilities through PjBL learning can occur if students are directly involved in the learning process with clear directions, and pay attention to essential aspects such as learning activities, optimal use of time (Yunita et al., 2021).

Various research related to PJBL has been carried out in various countries, such as Anazifa and Djukri (2017) in Indonesia which researched PJBL as an effort to improve thinking skills; Almulla (2020) in Saudi Arabia researched the effectiveness of PjBL as a way of involving students in learning; Brassler and Dettmers (2017) in Germany regarding how to increase interdisciplinary competence in PjBL; Lin et al., (2021) in Taiwan regarding PjBL to improve design thinking, and Mustapha and Ichsan (2018) in Malaysia regarding PjBL evaluation. Apart from that, in the period 2017-February 2024 in the Scopus database there are 200 articles discussing PjBL, but the research subjects involving junior high school students tend to be few and focus on upper secondary school (SMA) students and university students. Apart from that, of the many existing articles, none has discussed the implementation of PjBL with a review of learning outcomes, creativity, and student attitudes in proving the formula for the area and circumference of a circle in junior high school mathematics lessons.

This research is important to be carried out to be able to provide an overview of how to prove the formula for the circumference and area of a circle in junior high school (SMP) mathematics learning. Through the results of this research, information regarding the use of PjBL is becoming increasingly widespread among educators in Indonesia, the results of this research will also be later become the basis for

development research in mathematics learning, apart from that the results can also be used by teachers as a prototype in PjBL implementation. Therefore, the aim of this research is to analyze the effectiveness of learning through the implementation of project-based learning (PjBL).

2. Methods

This research included quantitative research with pre-experimental methods, the research design was one group pretest-posttest which was carried out in October-December 2023. This research involved 1 class consisted of 20 students at one of the Junior High Schools (SMP) in South Sulawesi Province. Data collection techniques included: 1) the test consists of 5 essay questions related to the circumference and area of a circle with cognitive level C5, scoring student answers using a rubric on a scale of 1-10; 2) attitude assessment observation sheet which measures the attitude of mutual cooperation, critical reasoning, thoroughness and responsibility, scoring the attitude assessment using a scale of 1-4; 3) skills assessment sheet that measures the ability to observe, ask questions, explore, process data, and communicate, skill assessment scoring is measured using a scale of 1-4; 4) project assessment sheet, measuring indicators: a) project implementation stage consisting of tasks in the project and project creation time; b) the results stage consists of originality, creativity, and conceptual; c) the presentation stage consists of the use of language and clarity of delivery. All research instruments were tested for validity and reliability before being used. Data analysis techniques use: 1) descriptive analysis by determining the average pretest and posttest scores; 2) inferential analysis using paired-sample t-test with normality test requirements using the Shapiro Wilk test

3. Results and Discussion

This research was carried out over 6 meetings, starting with giving a Pre-test, action treatment for 4 meetings, and ending with a post test. The level of mastery of concepts and learning outcomes is measured through learning outcomes tests. The optimal achievement of these parameters can be influenced by the learning model applied. A comparison of the results of the Pre-test and post-test is described in table 1.

Table 1. Pre-Test and Post Test Learning Results

Items	Pre-Test	Post-Test
Mean	77.35	87.80
Maximum	88	100
Minimal	60	70
Range	28	30
Standard Deviation	6.52	8.82
Standard Error	1.45	1.97

Achieving learning outcomes is one of the parameters of learning success. Based on the results of the descriptive analysis presented in Table 1, the Pre-test score was 77.35 with the highest score was 88 and the post-test was 87.80 with the highest

score of 100. This data shows an increase in learning outcomes after implementing PjBL.

Furthermore, based on the results of the prerequisite test through the normality test based on the opinion of Santoso (2019) that the data is said to be normally distributed if the Shapiro Wilk test if the sig. Greater than 0.05. Based on the normality test results, the Sig value was obtained. (Pre-test = 0.127; posttest = 0.369) where this research data meets the requirements and is normally distributed. Thus, the data can be analyzed using the Paired-Sample T-Test. The results of the Paired-Sample T-Test are presented in Table 2.

Table 2. Paired-Sample T-Test Results

Items	Score
Correlation Pair Pre and Posttest	0.661
Mean Paired Differences	-10.45
Lower	-13.56
Upper	-7.33
Sig.	0.00
t	7.02

Based on the data from the Paired-Sample T-Test results in Table 2, the sig value = 0.00 < 0.05 and the calculated t value = 7.02 > t table 2.08. The results of the hypothesis test show that there is a significant difference between the Pre-test and pos test after implementing PjBL, the average student learning outcomes after implementing PjBL are higher than student learning outcomes before the action. Therefore, the application of PjBL in learning has been proven to be able to significantly empower students' knowledge and competencies. So, it can be concluded that there is a difference between the average learning outcomes of the Pre-test and the post test, which means that there is an influence of implementing PjBL in improving student learning outcomes.

Next, student skills are measured using a skills assessment sheet which measures the ability to observe, ask questions, explore, process data, and communicate. Skill assessment scoring is measured using a scale of 1-4. Based on the data in table 3, it was found that the average student skills reached a score of 3.5 or 87.50, where this figure is in the very good category. The results of measuring student skills are described in Table 3.

Table 3. Student Skills Measurement Results

Items	Average score
Observe	3.75
Ask	4
Exploring (Gathering Information)	3
Associating (Processing Data)	3.25

Communicate	3.5
Score	3.5
Mark	87.5

In the learning process by implementing the PjBL model, students are given the opportunity to work on projects which are products of the learning process. Project assessment is measured through three stages, namely the project implementation stage, project results stage, and presentation stage. The average student project assessment results reached 3.63 or 90.80, which is included in the very good category. A recapitulation of student project assessment results is described in Table 4.

Table 4. Student Skills Measurement Results

Items	Average value
Implementation Stage	3.90
Results Stage	3.70
Presentation Stage	3.30
Score	3.63
Mark	90.80

The next indicator measured in this research is related to student attitudes. Student attitude assessment is measured using an attitude assessment observation sheet which measures the attitude of mutual cooperation, critical reasoning, conscientiousness and responsibility, scoring the attitude assessment using a scale of 1-4. The average student attitude assessment results reached 3.33 or 83.33, which is included in the very good category. A recapitulation of the results of student attitude assessments is described in Table 5.

Table 5. Student Attitude Assessment Results

Items	Average value
Mutual cooperation	3.58
Critical Reasoning	3.42
Responsibility	3.00
Score	3.33
Mark	83.33

The results of this research show that the implementation of PjBL has an effect on student learning outcomes. It is found that the value of student learning outcomes after implementing PjBL is higher than before implementing PjBL. The results of this research are in line with several previous research reports, such as Rahardjanto and Fauzi (2019) with research results showing that the implementation of Hybrid-PjBL has a significant influence on achieving learning outcomes and creative thinking

abilities; implementation of the PjBL learning model can improve student performance and learning outcomes (Mulyadi, 2015; Guo *et al.*, 2020; Mahasneh and Alwan, 2018; Yunita *et al.*, 2021; (Prajoko *et al.*, 2023; Santyasa, Rapi and Sara, 2020).

In implementing PjBL, apart from being found to be able to improve learning outcomes, it was also found to be able to improve student skills which include the ability to observe, the ability to ask questions, the ability to explore, the ability to process data, and the ability to communicate ideas. PjBL contains collaborative learning, iterative learning, and authentic learning which ultimately results in student involvement. The results of this research also show that PjBL can increase student involvement in sharing knowledge and information. These results strengthen previous research that the implementation of PjBL can improve students' skills and activity, such as research conducted by (Almulla, 2020; Barak and Yuan, 2021); PjBL is able to encourage students' creative thinking, especially those related to fluency and flexibility, and can significantly increase students' creativity (Chen et al., 2022); Collaborative and interdisciplinary PjBL was found to be efficient in improving students' technological and collaborative skills (Baser, Ozden and Karaarslan, 2017); PjBL is an instructional approach designed to utilize students' motivation to be active and understand

In line with these findings, Husamah (2015) stated that PjBL is learning that has the potential to develop students' thinking abilities better. Further research states that PjBL has the potential to stimulate three components of thinking skills, namely self-regulation, critical thinking skills, and creative thinking skills; and PjBL has a significant influence on achieving learning outcomes and creative thinking abilities (Rahardjanto and Fauzi, 2019). Furthermore, it has also been found from previous research that PjBL is better than other learning models, increasing skills shows different results between the PjBL experimental group and the control group as stated by (Muhibbuddin, Yustina and Safrida, 2020; Naji et al., 2020; Mulyani and Arif, 2021; Fadhil, Kasli and Halim, 2021; Huang, London and Perry, 2023).

PjBL was also found to be able to foster students' positive attitudes in learning. In this research, students' attitudes in the learning process were measured using three indicators, namely cooperation, critical reasoning, conscientiousness and responsibility. The result is that the average student attitude assessment results reached 3.33 or 83.33, which is included in the very good category. This finding is in line with the opinion of Vidergor, (2022); Fauzia and Kelana (2020); that PjBL is a key strategy for creating independent learners, students solve real world problems by designing their own problems, creating questions, planning their learning, and can organize many strategies so as to foster a positive attitude in learning; PjBL has increased students' enthusiastic learning attitudes, student creativity, and increased student competence (Latip and Supriatna, 2023).

Wirantini et al., (2016) also said that the learning atmosphere using the PjBL model creates conducive learning interactions between students, teachers, and students, encouraging students to carry out various learning activities. Enthusiastic students are shown by seriously carrying out various learning activities during the learning process. This activity raises students' courage to ask questions, express

opinions and give suggestions so that the interactions that occur in the learning process can change student behavior for the better.

The findings of this research conclude that: 1) There is a significant difference between the Pre-test and the post test, the average student learning outcomes after implementing PjBL are higher than student learning outcomes before the action, PjBL is proven to be able to significantly empower students' knowledge and competencies; 2) student skills measured through the ability to observe, ask questions, explore, process data and communicate meet the very good category; and 3) students' attitudes in the learning process which include mutual cooperation, critical reasoning, thoroughness and responsibility meet the very good category. Thus, Project Based Learning (PJBL) is effectively implemented to improve student learning outcomes, skills and attitudes.

Despite the success of this research, the limitations of this research are also explained, namely that this research only involved one class at one school without any comparison of the involvement of students in other schools, therefore, for further research it is recommended to involve students from different regions or countries. different. The implications of this research explain the effectiveness of implementing PjBL to improve student learning outcomes, skills and attitudes. These findings expand information and recommendations for teachers so they can carry out good practices in improving the quality of learning processes and outcomes through implementing PjBL.

4. Conclusions

In this research, the effectiveness of learning through the implementation of project-based learning (PjBL) was analyzed. The research results concluded that Project Based Learning (PJBL) is effectively implemented to improve the quality of research processes and results. Effective indicators are measured by three indicators, namely: 1) Learning outcomes after implementing PjBL reach a very high level. There is any significant difference between the Pre-test and the post test, the average student learning outcomes after implementing PjBL are higher than student learning outcomes before the treatment, PjBL is proven to be able to significantly empower students' knowledge and competencies; 2) a series of learning activities carried out by students in PjBL such as observing skills, asking questions, exploring, processing data, and communicating are able to empower students' skills so that students' skills meet the very good category; and 3) students' attitudes in the learning process which include mutual cooperation, critical reasoning, thoroughness and responsibility meet excellent category.

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