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Implementation of Project-Based Learning Models to Improve Activities and Learning Outcomes in Stone Plumbing Practice

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ABSTRACT
This study aims to increase student activity and learning outcomes by applying a project-based learning model in the Plumbing Stone Work Practice course for Building Engineering Education students, a total of 75 students. This study consisted of two cycles, each cycle consisting of two meetings, where each session had four stages consisting of planning, action, observation, and reflection stages. The application of project-based learning can increase student learning activities where student learning activities experience an increase in cycle I obtained a score with an average activeness score of 65.33% and an increase in cycle II received an average of 97.89%, which means there is an increase of 38.78%. The application of project-based learning can improve student learning outcomes where the average student learning outcomes have increased by 17%. In cycle I with an average percentage of post-test results of 84%, it grew in cycle II with an average percentage of post-test results of 99%. The classical completeness of the research class can be achieved by 99% which is greater than the researcher's expectations. From the results of the study, it can be concluded that the application of a project-based learning model in the Plumbing Stone Work Practice course can increase student activity and learning outcomes.

Keywords: *Project-Based Learning, Learning Activities, Learning Outcomes.*

1. INTRODUCTION

The Indonesian educational system has adopted a number of strategies to aid in the learning process. The learning process, specifically the educational learning process, must be carried out successfully, inspiring, enjoyable, challenging, able to encourage students to actively participate, and provide enough room for initiative, creativity, and independence in accordance with students' talents, interests, physical development, and psychological growth [9]. The indication is that lecturers as actors in the learning process in class must be able to plan, design, and apply real and concrete learning, so that the learning carried out can be successful and in accordance with educational goals. In Indonesia, education can be pursued in 3 ways, pecifically, formal, informal, and non-formal education. Basic education, secondary education, and higher education are the three tiers that make up formal education. Non-formal education, meanwhile, is an alternative educational route to formal education that can be carried out in a structured, tier-based manner. [10].

The Building Engineering Education Study Program, Faculty of Engineering, Medan State University has been active since the founding of the LPTK (IKIP Medan). In accordance with technological advances and the needs of the industrial world, many things have changed in the PTB Study Program curriculum. The achievement of study program graduates is to make PTB graduates become professional lecturers in their fields. Therefore, several courses at PTB emphasize practice rather than theory. Plumbing masonry practice is a mandatory practical course in semester 3. This course is oriented towards making students able to plan and design simple buildings. The science that underpins the development of technological infrastructure, particularly building infrastructure, is building construction work [15]. The material consists of cleaning the field, installing bow plank, foundation, sloof work, wall pairing work, tile and ceramic installation work, plastering work, and molding techniques

There are still some students who do not demonstrate competence in the learning outcomes for the acquisition of stone and plumbing work practice. The results of the cognitive analysis of 75 students showed that 57.14% were in the poor category, 25% were in the sufficient category, 14.28% were in the good category and 3.57% were in the very good category. The results of the psychomotor analysis for the plumbing stone work practice course were 50% in the poor category, 28.57% in the sufficient category, 14.28% in the good category, and 7.14% in the very good category. From these data, it is necessary to carry out learning that can improve learning outcomes in stone and plumbing work practice courses, namely by applying a learning model. The appropriate learning model to improve learning outcomes from a cognitive and psychomotor perspective is to use a problem-based learning model. Problem-based learning is learning that tends to be activities for solving problems, and solving these problems must be problems that have not been structured optimally (ill-structured problems), so that these problems can challenge students to be able to think and have group discussions [2]. Students work in groups to develop problem-solving skills as they tackle real or simulated problems, discuss the appropriate course of action, and negotiate a solution.

The research objective of applying the project-based learning model to increase learning activities and outcomes in the plumbing stone work practice course is to determine the increase in learning activities and to determine the increase in student learning outcomes.

2. METHODOLOGY

This research was conducted at the Faculty of Engineering, Medan State University, Department of Building Engineering Education in the Masonry and Plumbing Practice Course in the 2022/2023 even semester academic year. The research subjects were 3 classes of stone and plumbing practice students consisting of 75 students

This research is a Class Action Research (CAR) with reference to the theory of Kemmis and Mc Taggart. In CAR, there are two cycles, and each cycle consists of two meetings. Action planning, action implementation, observation (observation), and reflection are the first four stages of a cycle.

The Kemmis and McTaggart models [17] explain each stage as follows:

a. Action planning, namely designing all the needs of carrying out classroom action research starting from teaching materials, teaching materials, and teaching plans.
b. Implementation of the action begins with conducting a pre-test to determine students' initial abilities in the learning process by asking questions according to the material being taught.
c. Observation: The observation phase is focused on when students work on projects with reference to student worksheets and at the end of the practice a test is carried out to determine the student's final ability.
d. Reflection: The results of observations of activities and learning outcomes that have been carried out, collected, and analyzed, so that conclusions are obtained from the actions that have been taken. The minimum completeness criterion of 65 must be achieved by students both for their activity and for their learning outcomes. Class classical completeness is also designed to reach 85% of the total number of students. This research is said to be successful if all the design assessment activities and learning outcomes have passed the research design. If the reflection results are still not in accordance with the researcher's design then it will be continued with cycle II. The implementation of this action research was carried out in two cycles and each cycle was completed until competency standards in learning had been achieved

2.1. Project-Based Learning Model

The learning model is a conceptual framework that outlines systematic methods for planning learning and learning experiences to achieve goals and acts as a manual for lecturers when developing lesson plans. [12]. The learning model is a strategy or a pattern used to determine the learning resources, such as textbooks, movies, computers, curricula, and others when planning tutorials or classroom instruction. [15].

The following [6] are connected to how effectively PBL is used to improve learning outcomes: (a) Well-designed PBL offers students the chance to develop project-related skills, (b) Working in teams, managing projects under a team leader, (c) Oral and written communication, (d) Self-mastery and ability to evaluate group work (e) Able to work individually, (f) Think critically in analyzing, (g) Able to explain project concepts, (h) Independent learning, (i) Able to apply projects to the world of work, (j) Able to research and summarize information literacy, and (k) Able to solve various cross-disciplinary problems.

2.2. Characteristics of the Project-Based Learning (PBL) Model

The characteristics of PBL are developing students' thinking skills which enable them to be creative, and skilled, and encourage them to work together [5]. PBL [17] has characteristics, namely: (a) Students as decision-makers, and create frameworks, (b) There are problems so they can be made, (c) Student design project processes to achieve results, (d) Students are responsible for information collected, (e) Carry out continuous evaluation, (f) Evaluate what has been done in the project, (g) Students continuously analyze the project, (h) There is a product as the final result of the project, (i) PBL makes the class have an atmosphere to change.

2.3. PBL syntax

The PBL model requires students to study and produce work, therefore this model can increase student motivation to learn, improve student problem-solving skills and increase student cooperation in group work [13]. The PBL steps [3] include: (a) Making basic questions to stimulate students in learning in the form of questions so that students are curious to carry out investigations; (b) designing projects by giving students the opportunity to identify problems and formulate hypotheses and project work plans; (c) prepare a schedule for the design of project activities; (d) monitor students as part of monitoring to avoid the risk of project errors; (e) Conduct tests based on hypotheses; (f) make general and specific conclusions during the project process.

3. RESULTS AND DISCUSSION

3.1. Result

The CAR implementation stage is carried out in 2 cycles, where each cycle consists of 2 meetings. Each cycle consists of the planning, implementation, observation, and reflection stages. The action planning stage applies the project-based learning model in the learning process as follows:

a. Coordinate and cooperate with lecturers to discuss the research carried out.
b. Preparing learning tools such as syllabus, lesson plans, and teaching materials that will be studied in the Project-based Learning process
c. Prepare research instruments
d. Prepare observation sheets of student learning activities

The implementation phase was carried out throughout April 2023 on stone installation material which was carried out by 3 student groups consisting of 25 students per group according to the lecturer's directions. The lecturer explains the terms and conditions in implementing the project that must be achieved. Then the lecturer gives a floor plan to make different masonry constructions for each group and discusses the assignments that have been given. Each group is given freedom in planning the desired project. After the masonry and plumbing practices, the lecturer then instructed each group to present the results of the projects that had been done and provide an assessment of the projects that had been done by students. The same thing was also done for the second meeting in the first cycle.

The results of observing student learning activities in cycle I, meeting I, and meeting II were obtained as shown in Table 1 and followed by Figure 1 which shows a graph of the percentage of student activity.

Table 1 and Figure 1 below show that student learning activities have not reached the research target, where in stage I those who received the inactive category totaled 26 students from the three student groups or an average of 34.67%. The average student who is quite active is 41.33%, the average student who is active is 16% and the average student who is very active is 8%. From the results of observing learning activities in cycle I, improvements are still needed in the implementation of the next cycle.

Table 1. Results of Cycle 1 Learning Activities

No.	Grade	Group			Category
		I	II	III	
1	< 65	11	7	8	Not active
2	65 - 74,99	10	10	11	Pretty active
3	75 - 84,99	4	4	4	Active
4	85 - 100	0	4	2	Very active
Total		25	25	25	

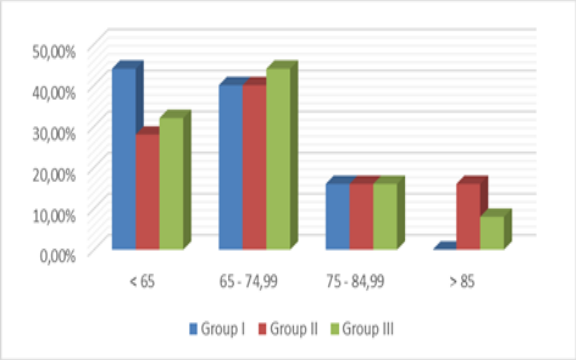

Figure 1. Student Activity Percentage Graph Cycle I

The following step is to evaluate the outcomes of pre- and post-tests used to gauge student performance in this cycle. This is being done in order to determine whether using based learning models can enhance student learning outcomes.. Based on the results of research conducted on 75 students, the learning outcomes in cycle I were presented in Table 2. And Table 3. The following

Table 2. Learning Outcomes of Cycle I

No.	Grade	Group I		Group II		Group III		Category
		Pre-test	Post test	Pre-test	Post test	Pre-test	Post test	
1	< 65	14	2	8	4	13	6	Incompetent
2	65 - 74,99	6	8	10	8	8	9	Competent
3	75 - 84,99	5	11	6	10	4	8	Competent
4	> 85	0	4	1	3	0	2	Very Competent
Total		25	25	25	25	25	25	

Table 3. Percentage of Learning Outcomes Cycle I

No.	Grade	Group I		Group II		Group III		Mean	
		Pre-test	Post test	Pre-test	Post test	Pre-test	Post test	Pre-test	Post test
1	< 65	56%	8%	32%	16%	52%	24%	47%	16%
2	65 - 74,99	24%	32%	40%	32%	32%	36%	32%	33%
3	75 - 84,99	20%	44%	24%	40%	16%	32%	20%	39%
4	> 85	0%	16%	4%	12%	0%	8%	1%	12%
Total		100%	100%	100%	100%	100%	100%	100%	100%

Based on the results of the activities and learning outcomes from the first cycle that has been carried out, then at the end of the lesson, a reflection is made on the learning process that has been carried out. Implementation of learning in the first cycle there are some weaknesses that occur. The weaknesses and solutions in cycle I are as follows:

a. Students are not familiar with the creation of learning conditions that lead to the PBL model
b. During the learning process students still feel that they are not ready for the pPBL model, so students are less active in the learning process.
c. The activity of students in the group is still low, this happens because there are still some students who are less serious in the group with a low indicator of success, namely 65.37%.
d. Student learning outcomes in groups are still low, this happens because they have not yet achieved a completeness score with a low success indicator, namely 84% in the post-test.
e. Cycle II must be completed because the value of student learning activities and student learning outcomes is still below the standard of success and has not yet attained the success indicators of classical completeness.

To correct deficiencies in Cycle I, the implementation of Cycle 2 can be planned as follows:

a. The lecturer directs, explains, and gives understanding back to students of how the learning conditions are by using a PBL.
b. Providing more comfortable learning and providing additional value to students who are active in learning, for example by asking questions and giving opinions during learning in order to provoke student activity in learning.
c. In order to achieve success indicators with a percentage of 85%, students must take their education more seriously and complete cycle II.
d. Cycle II also consisted of two meetings and went through four stages, namely planning, implementing, observing, and reflecting, as follows:

Based on the reflection results from cycle I, planning in cycle II required re-planning. This is done so that the activities and student learning outcomes in the previous cycle increase in this cycle, the following planning is needed:

a. Coordinate with lecturers to analyze the space that occurred in cycle I to be corrected so that these errors do not recur in the next cycle.
b. Setting up learning devices
c. Preparing research instruments for student learning outcomes
d. Prepare observation sheets of student learning activities

Observational exercises are done while teaching and learning are taking place. From the start of the observation to its conclusion, researchers observed student learning activities and student learning outcomes. From the results of these observations, data on student learning activities will be obtained. The results of observing student learning activities in cycle II were obtained as shown in Table 4.

Table 4. Results of Cycle II Learning Activities

No.	Grade	Group			Category
		I	II	III	
1	< 65	3	2	2	Not active
2	65 - 74,99	7	8	5	Pretty active
3	75 - 84,99	10	12	12	Active
4	> 85	5	3	6	Very active
Total		25	25	25	

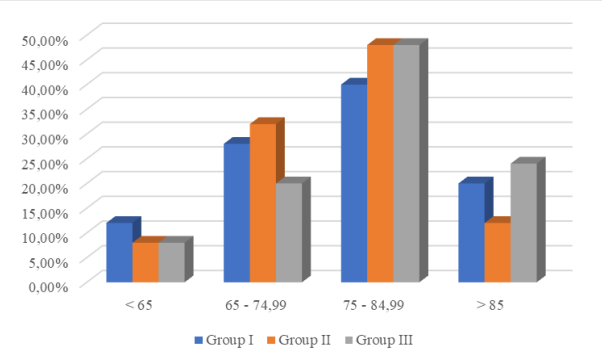

Figure 2. Student Activity Percentage Graph Cycle II

From Table 4 above it is known that student learning activities have increased from the previous cycle, where at the first meeting the inactive category was obtained with an average percentage of 34.67%, quite active with an average percentage of 41.33%, active with an average percentage of 16%, and for the very active category, there are 4 students with a percentage of 16%. Furthermore, at the second meeting which was held, students received an inactive category with an average percentage of 3.11%, quite an active category with a percentage of 8.89%, an active category with an average percentage of 15.11%, and for the very active category with an average percentage of 6.22%.

Table 5. Learning Outcomes of Cycle II

No.	Grade	Group I		Group II		Group III		Category
		Pre-test	Post test	Pre-test	Post test	Pre-test	Post test	
1	< 65	9	0	6	1	9	0	Incompetent
2	65 - 74,99	4	5	8	4	6	6	Competent Enough
3	75 - 84,99	8	11	6	13	8	12	Competent
4	> 85	4	9	5	7	2	7	Very Competent
Total		25	25	25	25	25	25	

The following step is to evaluate the outcomes of pre- and post-tests used to gauge student performance in this cycle. This is being done to see if using project-based learning models (also referred to as project-based learning) can enhance student learning outcomes. The

findings from a study that involved 25 students are displayed in Tables 5 and 6.

The results of the pre-test and post-test that had been conducted were obtained based on Table 6 for the acquisition of student learning outcomes in cycle II.. Where in the pretest it is known that the category is incompetent with an average percentage of 32%, the category is quite competent with an average percentage of 24%, the competent category with an average percentage of 29%, and the very competent category with an average percentage of 15%. After learning, a post-test was also carried out at the end of the lesson, it was found that there was an increase in student learning outcomes in this cycle. Where in the post-test it was found that only an average percentage of 1% of students were in the incompetent category, the fairly competent category obtained an average percentage of 20%, the competent category with an average percentage of 48%, and the very competent category with the average percentage is 31%.

Table 6. Percentage of Learning Outcomes Cycle II

No.	Grade	Group I		Group II		Group III		Mean	
		Pre-test	Post test	Pre-test	Post test	Pre-test	Post test	Pre-test	Post test
1	< 65	36%	0%	24%	4%	36%	0%	32%	1%
2	65 - 74,99	16%	20%	32%	16%	24%	24%	24%	20%
3	75 - 84,99	32%	44%	24%	52%	32%	48%	29%	48%
4	> 85	16%	36%	20%	28%	8%	28%	15%	31%
	Total	100%	100%	100%	100%	100%	100%	100%	100%

Based on the findings of cycle II PBL research, it was discovered that student learning activities and outcomes increased from cycle I to cycle II. The reflections that can be taken from cycle II are as follows:

a. Related to student learning activities, where students experience an increase at each meeting in each cycle that is assessed.
b. Student learning outcomes from the data obtained have increased where in cycle II there were no more students who were in the incompetent category, exceeding the minimum completeness criteria, thus it was concluded that cycle II had reached the target with a success percentage of ⩾ 85%.

3.2. Discussion

The findings of this study suggest that incorporating PBL into a masonry and plumbing practice course with masonry installation material can increase student engagement and learning outcomes. PBL is an innovative learning model that is appropriate to help students be active in learning, think critically, as well as be skilled and innovative. This is in line with BIE's [17] opinion, which claims that the PBL model is a learning strategy that encourages students to engage in problem-solving and critical thinking, is skilled and gives them the chance to work independently, with the ultimate goal of producing realistic work. A learning activity that aims to develop attitude, knowledge, and skill competencies is the project-based learning model. [16]. The findings of this study concur with those of previous research [8], which found that PBL implementation can enhance student learning outcomes.

Student activity peaked in the second cycle at 90.67% after reaching 65.33% in the first cycle. These findings indicate that there was a 38.78% increase in student activity. The same is true of the learning objectives that were completed in cycles 1 and 2. Cycle I saw an average post-test learning outcome percentage of 84%, and cycle II saw an average post-test learning outcome percentage of 99%. Overall, there was a 17% increase in the percentage of learning outcomes. This is consistent with the theory put forth [16], according to which project-based learning is a type of learning model that gives professors the ability to direct learning in a classroom setting by incorporating project work. The project work itself consists of challenging questions and problems that are based on complex assignments that give students the chance to work independently while also requiring them to design, solve problems, make decisions, and conduct investigations.

The indicator of the success of this class action is marked by an increase in student learning outcomes and learning activities through the application of the Project Based Learning model with an average grade reaching KKM 65 with a percentage of classical completeness reaching ⩾ 85%, i. e. an average percentage reaching 99%.

4. CONCLUSION

Following is a conclusion that can be drawn from the research's findings:

a. The application of PBL can increase student learning activities. This can be seen from the results of observations (observations) of student learning activities which have increased where in cycle I the value obtained with an average score of activeness shifted by 65.33% and increased in cycle II received an average of 97.89%, which means there is an increase of 38.78%.
b. The use of PBL can enhance student learning outcomes, with an average increase of 17% in these outcomes. It increased from cycle I, where the average post-test result percentage was 84%, to cycle II, where the average post-test result percentage was 99%.

Based on the results and conclusions of the study, it shows that implementing PBL can increase student learning activities and outcomes in the Stone and Plumbing Practice course. The PBL model is a learning model that helps students be active in learning, think critically, and be skilled and innovative. PBL also involves students in problem-solving activities and provides opportunities for students to work

autonomously so that students are able to understand a concept and principle in the subject so that learning objectives are achieved. This learning model also gives students the freedom to seek and find their own answers to a questionable problem, as well as compare the solutions they find themselves with the solutions found by other students and emphasizes the development of students' thinking skills through an in-depth identification process to find answers to problems that are directly obtained. independent. The results of the study prove that PBL has a significant influence on student learning activities and outcomes, as seen from the results of activity observations and the average student learning outcomes.

To follow up on the results of this research and to minimize existing limitations, the parties involved, such as the head of the workshop, lecturers, and students, must support each other in implementing PBL. Several roles must be carried out in implementing the project-based learning model, where the principal plays a role in planning, implementing, reflecting, and evaluating project developments, as well as forming teams, managing teaching staff resources, and building communication. Lecturers play a role in planning projects, becoming facilitators for students, and guiding and directing students in making projects. Meanwhile, students are required to actively participate in project-based learning activities.

Based on the results of data analysis and conclusions obtained previously, the suggestions taken from this study are as follows:

a. PBL has high learning activity for students in receiving learning material, so PBL needs to be implemented especially for practical courses
b. Effective PBL implementation will increase activity and produce positive learning outcomes.
c. Full support by related parties for each learning process and has a positive impact on lecturers and students to increase student learning activities and outcomes.

AUTHORS' CONTRIBUTIONS

Syafiatun Siregar (SS), Harun Sitompul (HS), Kinanti Wijaya (KW), and Siti Zulfa Yuzni (SZ) understand the ideas in research and conceived and planned the experiments. Both SS and HS developed the theory and performed analysis using a computize. KW and SZ help perform data analysis and verify it. SS, HS, KW, and SZ jointly compiled and wrote the manuscript

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REFERENCES

[1] Arikunto, et al., 2014., Prosedur Penelitian Suatu Pendekatan Praktik. Jakarta: Rineka Cipta.

[2] Dasa Ismaimuza., 2010., Pengaruh Pembelajaran Berbasis Masalah Dengan Strategi Konflik Kognitif Terhadap Kemampuan Berpikir Kritis Matematis Dan Sikap Siswa SMP, Jurnal Pendidikan Matematika, DOI: https://doi.org/10.22342/jpm.4.1.305.

[3] Devi., 2019., Penelitian Tindakan Kelas. Jakarta: Bumi Aksara.

[4] Djamarah., 2006., Strategi Belajar Dan Mengajar. Jakarta: Rineka Cipta.

[5] Indriani & Wharatno., 2019., Mengenal Penelitian Tindakan Kelas, Jakarta: Indeks

[6] Nilson, L. B. (2010). Teaching at its best: A research-based resource for college instructors (2nd ed.). San Francisco, CA: Jossey-Bass.

[7] Morin. A., 2012, Inner Speech., https://www.sciencedirect.com/science/referenceworks/9780080961804, https://doi.org/10.1016/B978-0-12-375000-6.00206-8

[8] Rusman., 2010., Model-Model Pembelajaran. Bandung: Mula Mandiri Fress.

[9] Peraturan Pemerintah No. 19 Tahun 2005 tentang Standart Nasional Pendidikan SNP

[10] Peraturan Pemerintah Republik Indonesia Nomor 13 Tahun 2015

[11] Sadirman., 2011., Belajar Dan Mengajar. Jakarta: PT. Bumi Atsa.

[12] Sagala., 2009., Konsep Dan Makna Pembelajaran: Untuk Membantu Dan Memecahkan Problematika Dalam Belajar. Bandung: Alfa Beta.

[13] Saputro & Rahayu., 2020., Mendesain Model Pembelajaran. Yogyakarta: Pustaka Belajar

[14] Sheldon, O. J., Dunning, D., & Ames, D. R., 2014., Emotionally Unskilled, Unaware, And Uninterested In Learning More: Reactions To Feedback About Deficits In Emotional Intelligence, Journal of Applied Psychology, 99(1), 125–137. https://doi.org/10.1037/a0034138

[15] Syafiatun, S., 2018., A Study of Work Based Learning for Construction Building Workers, Journal of Physics: Conference Series, Volume 970, Issue 1, article id. 012024, doi:10.1088/1742-6596/970/1/012024

[16] Thobroni., 2015., Pembelajaran berbasis proyek Yang Terpadu. Semarang: Rumpi Tekno.

[17] Trianto., 2015., Model Pembelajaran Terpadu. Jakarta: Bumi Aksara.