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The Influence Of Project-Based Learning On Concept Mastery, Self-Efficacy, And Student Collaboration In Grade Vii At Xyz Junior High School, West Jakarta

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Abstract: This study aims to test the effectiveness of Project-Based Learning (PjBL) model to improve concept mastery, self-efficacy, and collaboration skills for grade VII students in SMP XYZ. The data used to take from 55 students divided into two groups, namely the control group of 27 students and the experimental group consisting of 28 students. The students in the control group were given conventional learning (lecturing), while the students in the experimental group were given PjBL learning. The result of the assessment of students' concept mastery, self-efficacy, and collaboration skills were then tested using the difference test followed by the calculation of the n-gain value to determine the level of effectiveness of PjBL to improve concept mastery, self-efficacy, and collaboration. The result of this analysis indicates that PjBL is effective in improving concept mastery, self-efficacy, and collaboration skills. The results of different tests on concept mastery, self-efficacy, and collaboration before learning showed a significant p-value of 0.661 for concept mastery, 0.113 for self-efficacy and 0.612 for collaboration. While the different test after learning shows a significant p value of 0.000 in concept mastery and 0.024 in collaboration. In the N-Gain Score data from the results of the t-test in the experimental class and the control class shows a p-value of 0.000. The p value of the t-test on efikasi diri value data is 0.000.

Keywords:
Project-based learning, concept mastery, self-efficacy, and collaboration

Abstrak: Penelitian ini bertujuan untuk menguji efektifitas model pembelajaran berbasis proyek (PjBL) dalam meningkatkan penguasaan konsep, efikasi diri dan kolaborasi pada siswa kelas VII SMP XYZ. Data dalam penelitian ini 55 siswa yang terbagi dalam dua kelompok, yaitu kelompok kontrol sebanyak 27 siswa dan kelompok eksperimen terdiri dari 28 siswa. Siswa pada kelompok kontrol diberikan pembelajaran konvensional (ceramah), sedangkan siswa kelompok eksperimen diberikan pembelajaran PjBL. Hasil penilaian kemampuan penguasaan konsep, efikasi diri dan kolaborasi siswa diuji dengan menggunakan uji beda yang dilanjutkan dengan perhitungan nilai n-gain untuk mengetahui tingkat efektifitas PjBL dalam meningkatkan kemampuan penguasaan konsep, efikasi diri dan kolaborasi. Hasil analisis dalam penelitian ini menunjukkan bahwa PjBL efektif dalam meningkatkan kemampuan penguasaan konsep, efikasi diri dan kolaborasi. Hasil uji beda nilai penguasaan konsep, efikasi diri dan kolaborasi sebelum pembelajaran menunjukkan nilai p value signifikan sebesar 0.661 pada penguasaan konsep, sebesar 0.113 pada efikasi diri dan sebesar 0.612 pada kolaborasi. Sedangkan uji beda setelah pembelajaran menunjukkan nilai p-value signifikan sebesar 0.000 pada penguasaan konsep dan sebesar 0.024 pada kolaborasi. Pada data N-Gain Score dari hasil uji t-test pada kelas eksperimen maupun kelas kontrol menunjukkan nilai p value sebesar 0.000. Nilai p-value dari uji t-test pada data nilai efikasi diri ialah 0.000.

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INTRODUCTION

The curriculum in Indonesia is currently advancing and evolving in accordance with the developments in the world of education (Sholikhin, 2023). The domains of knowledge, skills, and attitudes are being developed. The current Pancasila Student Profile is being developed by the Indonesian government, specifically the Ministry of Education and Culture, as an effort to instill Pancasila character in all students (Hakim & Darojat, 2023) (Syafi'i et al., 2023). The developed profile consists of six aspects for Pancasila students: belief in God and obedience to God's commands, good behavior, acceptance of diversity, cooperation, having convictions, and thinking creatively and critically. One of the methods employed to achieve this is through project-based learning, also known as Project Based Learning (PjBL).

According to (Kusnadi & Gufran, 2022), the learning process conducted by educational institutions should be interactive, fostering creative abilities, motivating students to be active, providing space for students to express ideas, and instilling confidence in their abilities based on their interests, talents, and physical and psychological development. One alternative teaching technique to enhance the learning process in an engaging classroom environment is Project Based Learning.

As an effort to improve learning outcomes, it is necessary to conduct research on instructional models. Project Based Learning (PjBL) has been chosen as an endeavor to enhance student learning outcomes, particularly in Grade VII, which currently follows the Merdeka Curriculum requiring project-based learning. The selection of the PjBL model is expected to improve conceptual mastery, self-efficacy, and student collaboration.

Individuals with high self-efficacy are more likely to confidently present themselves (Phung et al., 2023). In participating in education, students should possess abilities and skills that support their future entry into the workforce. In the 21st century, collaboration and teamwork demand high levels of social skills (Owens & Browne, 2021). According to Fini in (Krsmanovic, 2021), students who collaborate in groups achieve far better results than those who work individually.

Based on observations and research, the researcher has identified several challenges faced by educators during teaching, including a lack of conceptual mastery, low self-efficacy, and insufficient collaboration. Therefore, the scope of this research is "The Influence of Project-Based Learning on Conceptual Mastery, Self-Efficacy, and Collaboration among Grade VII Students at SMP XYZ West Jakarta." This research focuses on improving conceptual mastery, self-efficacy, and collaboration among Grade VII students for better learning outcomes. While research on PjBL has been extensively conducted, this study narrows down the research scope to the implementation of PjBL according to the current Merdeka Curriculum at the Junior High School (SMP) level.

THEORETICAL FOUNDATION

Conceptual Mastery

Conceptual mastery refers to the ability to understand a concept, principles, and rules (Fatimatuzahroh et al., 2019), as stated in (Jusuf & Nasaru, 2022). Another perspective by Dahar in (Yensy, 2020) defines conceptual mastery as a student's ability to grasp an abstract concept and transform it into scientific knowledge. Anderson & Krathwohl, cited in Ahyana and (Syahri & Ahyana, 2021), explain that conceptual mastery is the ability of an individual to grasp the meaning of a knowledge concept acquired in their life activities. Conceptual mastery is assessed based on Bloom's taxonomy (1956) as follows: (1) Level C1, remembering, involves recalling information/material concepts learned; (2) Level C2, understanding, involves comprehending the meaning of a concept based on prior knowledge; (3) Level C3, applying, involves carrying out a procedure to solve a problem or complete a task; (4) Level C4, analyzing, involves describing and breaking down an object of inquiry; (5) Level C5, evaluating, involves making judgments based on established learning criteria and standards; (6) Level C6, creating, involves combining knowledge concepts and skills to produce a product

(Sumarni et al., 2019). Strong conceptual mastery helps students develop critical and profound thinking patterns.

Self-Efficacy

Self-efficacy is the belief within an individual regarding their capabilities, affirming their ability to perform a task or overcome a situation successfully (Abdullah, 2019). Self-efficacy can influence an individual experiencing anxiety toward their goals, as their strategies may be perceived as less effective. Strong self-efficacy correlates with lower levels of anxiety (Ningsih & Hayati, 2020). Through effective learning strategies, it is anticipated that students can engage in learning with heightened internal motivation, approaching tasks with awareness and responsibility to complete all assigned assignments.

Similarly, (Ormrod et al., 2016) assert that self-efficacy is an individual's belief in their ability to enact certain behaviors or achieve specific goals. According to (Santrock, 2021), cited by (Ningrum & Rahmawati, 2022), self-efficacy is an individual's belief in their capacity to master a situation and produce positive outcomes. Moreover, self-efficacy theory influences a student's tasks, efforts, perseverance, and academic achievements. Similar sentiments are echoed by (Schunk et al., 2012), who emphasize that self-efficacy is closely tied to self-belief in accomplishing tasks. Self-efficacy also impacts an individual's decision-making. Success in the learning process is supported by psychological aspects that substantially influence meaningful learning outcomes (Mesra & Kuntarto, 2021). In this context, self-efficacy serves as a foundation for assessing one's own abilities and attitudes, guiding actions toward achieving desired goals.

Collaboration

According to Keohane, collaboration refers to the act of working together as a team/group to achieve collective goals and success. This collaborative effort entails interdependence among members, which fosters coordination skills and nurtures mutual respect among team/group members (Pakpahan, 2023). Collaborative activities provide students with opportunities to learn from peers with diverse cognitive, affective, psychomotor, and other talents. Collaboration in education is an instructional technique that facilitates individuals interacting within small or large groups to solve academic problems. This approach involves social interaction, creative processes, cognitive conflicts among students, active listening, and responding to ideas presented by peers. These activities sharpen students' thinking skills and stimulate cognitive growth. Jean Piaget and Vigotsky posit that collaborative learning strategies are supported by three theories: 1) Cognitive theory, which emphasizes the exchange of ideas among students within a group during collaborative learning. This fosters creative thinking processes that train creative thinking abilities. 2) Social constructivism theory, suggesting that collaborative learning involves social interactions among group members that cultivate an attitude of respecting differing opinions. 3) Motivation theory, indicating that collaborative learning activities offer time and opportunities for group project work, fostering courage and mutual support among group members, motivating one another (Tan et al., 2021). Collaboration needs continuous development to equip students with skills in cooperation, coordination, communication, and expressing opinions to comprehend and solve problems. All these abilities can be cultivated through the implementation of collaborative learning models.

Project-Based Learning

PjBL is one of the learning models currently being developed in Indonesia as

part of the implementation of the Merdeka Belajar curriculum. The use of project-based learning is considered a scientific approach, as it engages students directly in acquiring knowledge through scientific methods. The implementation of PjBL is expected to make learning more engaging and innovative, enhancing conceptual mastery, self-efficacy, collaboration, and even nurturing critical thinking and communication skills, both written and oral. Furthermore, in the 21st-century skill set, collaboration is a recommended skill, making PjBL a suitable choice for implementation. Within collaborative activities among students, interactions allow them to share knowledge and learning experiences. Additionally, collaborative work fosters independent learning, where students are not solely reliant on teachers, but rather, they learn to understand concepts within groups, seeking broader knowledge. Several expert opinions on PjBL are as follows: 1) Learning is a process involving specific actions aligned with objectives (John, 1901). 2) Piaget and Vygotsky suggest that students should actively seek knowledge to construct and modify their initial understanding. The processes of seeking and constructing knowledge align with PjBL (Tan and Gong 2021, 5). 3) Project-Based Learning cultivates critical thinking and problem-solving skills. PjBL makes learning more contextual, motivating students to generate ideas for solving problems (Wang, 2020).

In Project-Based Learning, a contextual learning model is applied, providing detailed content understanding and practical experiences gained from family and the surrounding environment. Consequently, students need to equip themselves with 21st-century skills to prepare for a rapidly advancing technological and competitive workforce. This aligns with the Buck Institute for Education's Gold Standard for Project-Based Learning, aiming to achieve success in students' knowledge, understanding, and skills through student opinions, sustained statements, challenging projects, public products, critique and revision, and reflection. The advantages of Project-Based Learning include: (a) students learning through project-based models gain a deeper and lasting understanding of material concepts; (b) in specific subject matters, numerous studies show that project-based learning is more effective than traditional methods (Sayuti et al., 2020). PjBL's strengths lie in equity between high-performing and less proficient students, as well as in motivating student learning (Sayuti et al., 2020). The positive impact of PjBL includes: (1) students excel in problem-solving skills and practical application in daily life, (2) students engage more actively and independently. According to Khanifah's syntax in (Al Awab et al., 2021), PjBL has five characteristics: (1) the teacher as a facilitator, (2) essential questions, (3) consideration of student abilities, (4) active student problem-solving, (5) contextual learning. Another viewpoint by Savery in (Suseno et al., 2022) lists five characteristics of PjBL: 1) centrality, requiring skilled teachers to facilitate instruction, 2) constructive investigation, where projects are tailored to student abilities, offering new skills and knowledge, 3) autonomy, fostering activity during project execution, 4) student decision-making and involvement in problem-solving, 5) reality, with project topics being relevant and up-to-date. This accommodates students' diverse talents, skills, cognitive abilities, and attitudes. In conclusion, PjBL impacts students' learning outcomes in terms of knowledge, attitudes, and skills. Therefore, the implementation of the PjBL model influences students' conceptual mastery, self-efficacy, and collaboration skills. The researcher has constructed a conceptual framework as shown in the following diagram.

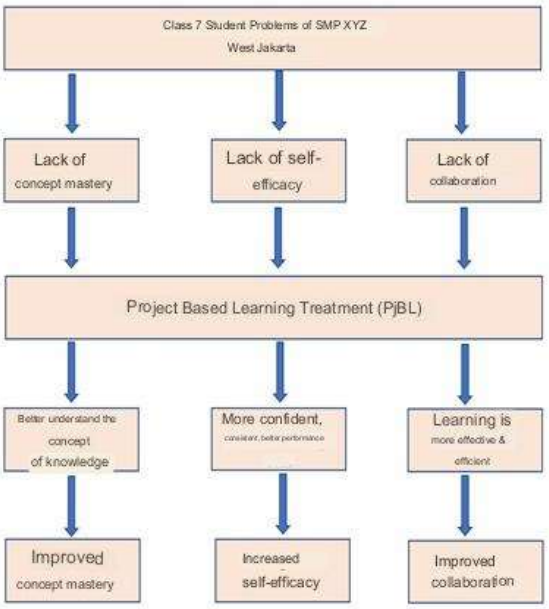


Figure 1. Thinking Framework Diagram

Research Hypothesis

Table 1. The hypothesis in this study

	H_0:	H_1:
1.	There is no difference in the results of the pre-test scores of students' mastery of concepts in the experimental class and the control class	There are differences in the results of the pre-test scores of students' mastery of concepts in the experimental class and the control class.
2.	There is no difference in the results of the post test scores of students' mastery of concepts in the experimental class and the control class.	There are differences in the results of the post test scores of students' mastery of concepts in the experimental class and the control class
3.	There is no difference in the N-Gain results of students' mastery of concepts in the experimental class and the control class	There are differences in the N-Gain results of students' mastery of concepts in the experimental class and the control class
4.	There is no difference in the results of the pre-test scores of students' self-efficacy in the experimental class and the control class.	There are differences in the results of the pre-test scores of students' self-efficacy in the experimental class and the control class
5.	There was no difference in the results of the post-test scores of students' self-efficacy in the experimental class and the control class.	There are differences in the results of the post-test scores of students' self-efficacy in the experimental class and the control class
6.	There is no difference in the results of the pre-test scores of student	There are differences in the results of the pre-test scores of student collaboration in the experimental class

	collaboration in the experimental class and the control class.	that applies the PjBL model to the control class
7.	There is no difference in the results of the post test results of student collaboration in the experimental class with the control class.	There are differences in the results of the post test scores of student collaboration in the experimental class with the control class

METHODS

Methodology in this research employs an experimental method with a pre-test & post-test group design. The research design involves two non-randomly assigned classes that receive different treatments in the subject of Pancasila Education for Grade VII in XYZ West Jakarta Junior High School. Class VII A serves as the experimental group, while Class VII E serves as the control group. The study aims to examine the influence of Project-Based Learning (PjBL) treatment on the conceptual mastery, self-efficacy, and collaboration of Grade VII students at XYZ West Jakarta Junior High School.

In this research, Class VII A was selected as the experimental group receiving PjBL treatment, while Class VII E was chosen as the control group receiving lecture-based treatment. Pre-tests were conducted before the experimental group received PjBL treatment and the control group received lecture-based treatment. These pre-tests aimed to assess the students' initial abilities before undergoing different treatments in the experimental and control classes. Subsequently, the experimental group underwent PjBL treatment, and the control group received lecture-based treatment. After the treatments were administered, both groups were given a post-test with questions equivalent to the pre-test. The results of the post-tests for the experimental and control groups reflect the students' conditions after receiving the treatments.

This research was conducted at XYZ West Jakarta Junior High School. The sample consisted of 28 students in Grade VII A (experimental group) and 27 students in Grade VII E (control group). The study took place during the second semester of the 2022/2023 academic year, specifically from the first week of February to the first week of March 2023. Learning conditions were conducted onsite, with students attending school.

The research employed an experimental method to assess the impact of PjBL treatment on the experimental group and the influence of lecture-based treatment on the control group. The study focused on Pancasila Education in Grade VII, second semester, with the topic of Diversity within the framework of "Bhinneka Tunggal Ika" (Unity in Diversity) (Hakim, 2023). The stages of Project-Based Learning (PjBL) include 1) Basic questions, 2) Project planning design, 3) Creating a project schedule, 4) Project monitoring, 5) Testing completed project outcomes, 6) Evaluating executed projects (Sani, 2014) (Parihah et al., 2023). As for the stages in lecture-based learning, they consist of 1) Preparation, 2) Implementation, and 3) Evaluation (Syaiful & Aswan, 2006).

Validity and Reliability Calculation

Regarding the conceptual mastery variable, assessment was conducted using pre-tests and post-tests in both sampled classes, VII A and VII E. The test questions were in multiple-choice format, totaling 25 items. For the conceptual mastery variable, if the results show that the experimental group performs better than the control group, it indicates that PjBL implementation influences conceptual mastery. The Pearson Correlation Validity Test for the Conceptual Mastery variable questionnaire revealed that 23 out of 25 pre-test & post-test

questions were valid, with 2 questions (items 19 and 20) being invalid. The following is the result of the Cronbach's Alpha Reliability Test for the Conceptual Mastery variable questionnaire.

Table 2. Concept Mastery Reliability Test Results

Reliability Statistics		
Cronbach's Alpha	N of Items	Keputusan
.784	25	Kuesioner Reliabel

Based on the table of Cronbach's Alpha reliability test results for the Conceptual Mastery questionnaire, the coefficient value of Cronbach's Alpha for all questions falls within the range of 0.4 to 1 (0.4 < Cronbach Alpha = 0.784 < 1). This indicates that all questions in the Conceptual Mastery questionnaire can be considered reliable in terms of their trustworthiness. The Pearson Correlation Validity Test results for the Self-Efficacy variable questionnaire indicate that all questions in the questionnaire are valid.

If the results show that the experimental group's scores are higher than the control group, it means that the implementation of PjBL has an impact on students' self-efficacy. The following are the results of the Cronbach's Alpha Reliability Test for the Self-Efficacy variable questionnaire.

Table 3. Reliability Test Results for Self-Efficacy

Reliability Statistics		
Cronbach's Alpha	N of Items	Keputusan
.971	35	Kuesioner Reliabel

Based on the table of Cronbach's Alpha reliability test results for the Self-Efficacy questionnaire, the coefficient value of Cronbach's Alpha for all questions falls within the range of 0.4 to 1 (0.4 < Cronbach Alpha = 0.971 < 1). This indicates that all questions in the Self-Efficacy questionnaire can be considered reliable in terms of their trustworthiness. The Pearson Correlation Validity Test results for the Collaboration variable questionnaire indicate that all questions in the questionnaire are valid.

In the t-test results, if it shows that the experimental group's scores are higher than the control group, it means that the implementation of PjBL has an impact on collaboration. The following are the results of the Cronbach's Alpha Reliability Test for the Self-Efficacy variable questionnaire.

Table 4. Reliability Test Results for Collaboration

Reliability Statistics		
Cronbach's Alpha	N of Items	Decision

	.978	35	Reliable Questionnaire

Based on the table of Cronbach's Alpha reliability test results for the Collaboration questionnaire, the coefficient value of Cronbach's Alpha for all questions falls within the range of 0.4 to 1 (0.4 < Cronbach Alpha = 0.978 < 1). This indicates that all questions in the Collaboration questionnaire can be considered reliable in terms of their trustworthiness.

RESULTS AND DISCUSSION

Descriptive statistical analysis is used to provide an overview of the research data. The data used in this study includes pre-test and post-test scores for conceptual mastery, self-efficacy, and collaboration from two different populations: the experimental group (PjBL model) and the control group (lecture model). The following is the result of the descriptive analysis of the research data.

Table 5. Descriptive Analysis Results of Data

	Number of Samples			Minimum Value			Maximum Value		
	Male	Female	Total	male	Female	Total	male	Female	Total
CM_pre1	14,00	14,00	28,00	52,00	44,00	44,00	92,00	92,00	92,00
CM_post1	14,00	14,00	28,00	80,00	80,00	80,00	100,00	96,00	100,00
SE_pre1	14,00	14,00	28,00	99,00	90,00	90,00	140,00	137,00	140,00
SE_post1	14,00	14,00	28,00	117,00	115,00	115,00	140,00	136,00	140,00
Collab_pre 1	14,00	14,00	28,00	81,00	97,00	81,00	140,00	140,00	140,00
Collab_post 1	14,00	14,00	28,00	84,00	92,00	84,00	140,00	140,00	140,00
CM_pre2	13,00	14,00	27,00	55,00	68,00	55,00	90,00	90,00	90,00
CM_post2	13,00	14,00	27,00	60,00	75,00	60,00	90,00	90,00	90,00
SE_pre2	13,00	14,00	27,00	94,00	99,00	94,00	140,00	140,00	140,00
SE_post2	13,00	14,00	27,00	94,00	99,00	94,00	140,00	140,00	140,00
Collab_pre 2	13,00	14,00	27,00	92,00	81,00	81,00	140,00	140,00	140,00
Collab_post 2	13,00	14,00	27,00	94,00	72,00	72,00	124,00	126,00	126,00

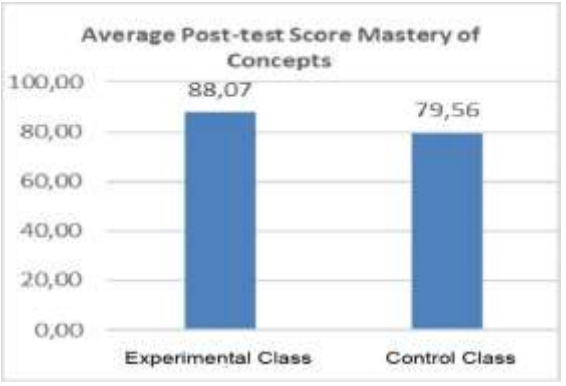
	Average value			Standard Deviation		
	male	Female	Total	male	Female	Total
CM_pre1	75,00	75,00	75,00	14,05	14,05	13,79
CM_post1	86,93	89,21	88,07	6,11	4,74	5,49

	109,5		108,0			
SE_pre1	7	106,57	7	11,61	12,46	11,91
	132,2		130,2			
SE_post1	1	128,29	5	6,68	5,31	6,25
Collab_pre	113,9		113,2			
1	3	112,50	1	19,91	14,65	17,17
Collab_post	118,7		115,8			
1	1	112,93	2	22,19	16,61	19,46
CM_pre2	71,38	78,43	75,04	10,37	6,55	9,16
CM_post2	76,15	82,71	79,56	8,00	5,30	7,40
	109,2		113,4			
SE_pre2	3	117,43	8	13,82	11,14	12,95
	109,5		113,6			
SE_post2	4	117,50	7	13,80	11,03	12,85
Collab_pre	112,0		116,3			
2	8	120,36	7	16,93	19,03	18,20
Collab_post	107,5		102,9			
2	4	98,71	6	11,35	13,72	13,18

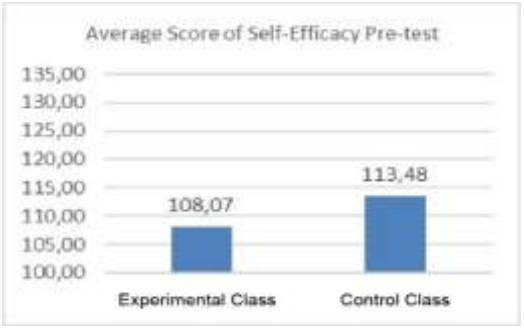
Source: Primary data processed in 2023

Below is the graph of the average scores derived from the data analysis in this study.

Grafik 1



Grafik 2



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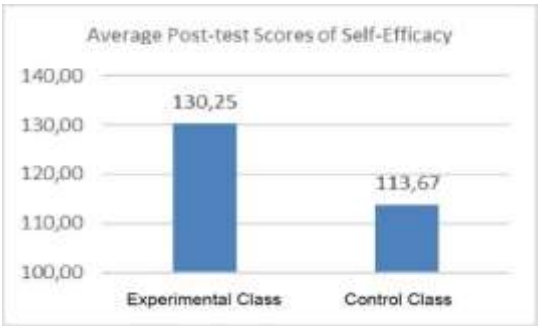

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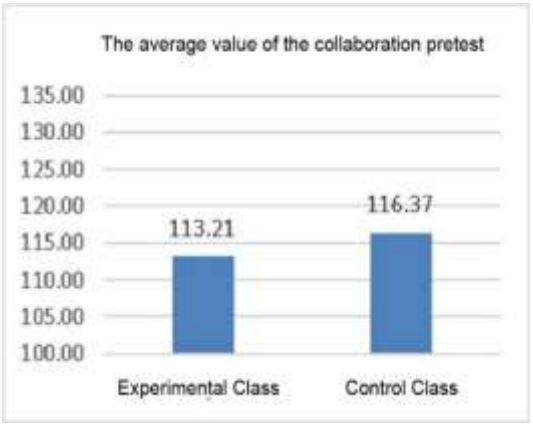
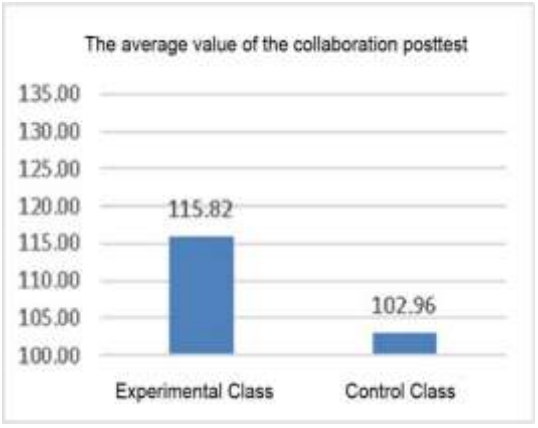
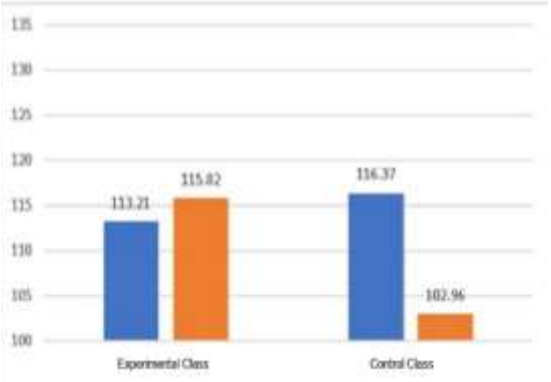


Grafik 5



Garfik 6



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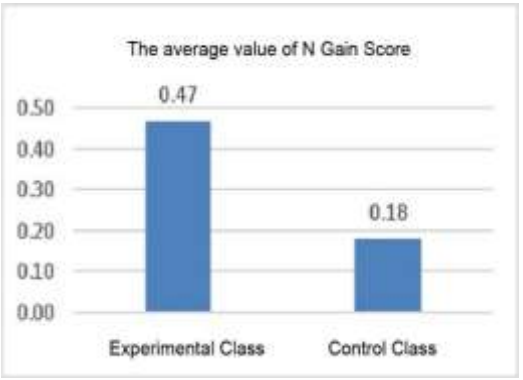
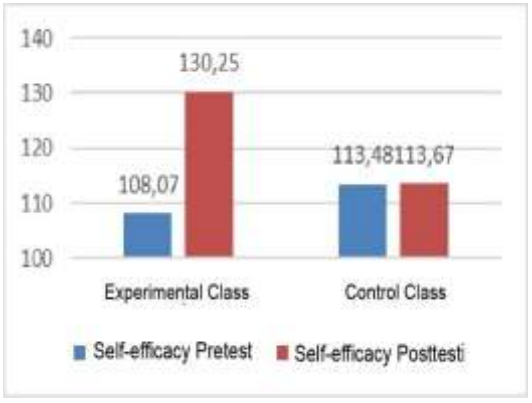
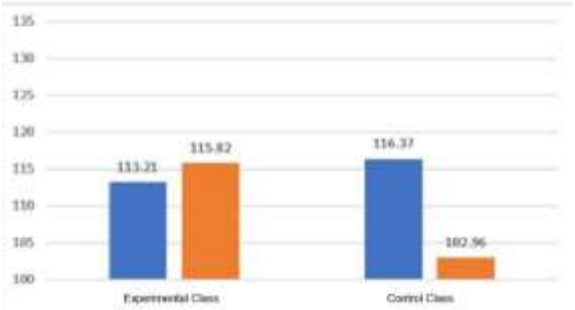


Grafik.8



Grafik 9

Grafik 10



Grafik 11

Explanation:

Graph 1 shows the average pre-test scores of concept mastery for the experimental class using PjBL and the control class using lecture method.

Graph 2 shows the average post-test scores of concept mastery for the experimental class and the control class.

Graph 3 displays the average pre-test scores of self-efficacy for the experimental class using PjBL and the control class using lecture method.

Graph 4 presents the average post-test scores of self-efficacy for the experimental class and the control class.

Graph 5 illustrates the average pre-test scores of collaboration for the experimental class and the control class.

Graph 4.6 depicts the average post-test scores of collaboration for the experimental class and the control class.

Graph 7 shows the increase in average concept mastery scores between the experimental class and the control class before and after the learning treatment.

Graph 8 represents the average N Gain Score for the experimental class and the control class.

Graph 9 displays the increase in average concept mastery scores for the experimental class and the control class.

Graph 10 illustrates the increase in average self-efficacy scores for the experimental class and the control class.

Graph 11 depicts the increase in average collaboration scores for the experimental class and the control class.

In this study, the calculation of N Gain score is done in a way that if post-test < pre-test, it is considered as 0 to reduce calculation bias (Coletta 2023). For the experimental class, the average N Gain score is 0.47, indicating that the overall increase in students' concept mastery from before to after using the PjBL method is at a moderate level. Meanwhile, for the control class, the average N Gain score is 0.18, indicating that the overall increase in students' concept mastery from before to after using the lecture method is at a low level. The table below presents the results of the normality test for the experimental class scores (applying the PjBL method) using the Kolmogorov-Smirnov test.

Table 6 Results of Normality Test for the Experimental Class

One-Sample Kolmogorov-Smirnov Test

		CMPRE1	CMPOST1	SEPRE1	SEPOST1	COLLABPRE1	COLLABPOST1	NGAINSCORE1
N		28	28	28	28	28	28	28
Normal Parameters[a,b]	Mean	75.0000	88.0714	108.0714	130.2500	113.2143	115.8214	46.7336
	Std. Deviation	13.78674	5.49025	11.91304	6.25167	17.17094	19.45756	29.57523

Most Extreme Differences	Absolute	.177	.184	.181	.083	.191	.146	.122
	Positive	.112	.184	.181	.059	.191	.122	.122
	Negative	-.177	-.104	-.116	-.083	-.119	-.146	-.115
Test Statistic		.177	.184	.181	.083	.191	.146	.122
Asymp. Sig. (2-tailed)		.024[c]	.016[c]	.019[c]	.200[c,d]	.010[c]	.129[c]	.200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

With a significance level of 5%, the data for post-test self-efficacy scores, post-test collaboration scores, and N-Gain scores of the experimental class are normally distributed. However, the data for pre-test concept mastery scores, post-test concept mastery scores, pre-test self-efficacy scores, and pre-test collaboration scores of the experimental class are not normally distributed. The following table presents the results of the normality test for the control class scores (applying the lecture method) using the Kolmogorov-Smirnov test

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Table 7 Results of Normality Test for the Control Class

One-Sample Kolmogorov-Smirnov Test

		CMPRE2	CMPOST2	SEPRE2	SEPOST2	COLLABPRE2	COLLABPOST2	NGAINSCORE2
N		27	27	27	27	27	27	27
Normal Parameters[a,b]	Mean	75.0370	79.5556	113.4815	113.6667	116.3704	102.9630	18.1015
	Std. Deviation	9.16298	7.39716	12.94774	12.85122	18.19795	13.18356	9.54494
Most Extreme Differences	Absolute	.113	.102	.188	.194	.125	.224	.101
	Positive	.051	.101	.188	.194	.123	.224	.101
	Negative	-.113	-.102	-.095	-.090	-.125	-.174	-.097
Test Statistic		.113	.102	.188	.194	.125	.224	.101
Asymp. Sig. (2-tailed)		.200[c,d]	.200[c,d]	.015[c]	.010[c]	.200[c,d]	.001[c]	.200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

With a significance level of 5%, the data of pre-test scores for concept mastery, post-test scores for concept mastery, pre-test scores for collaboration, and N-Gain Scores for the control class (using the lecture method) are normally distributed. On the

other hand, the data of pre-test scores for self-efficacy, post-test scores for self-efficacy, and post-test scores for collaboration for the control class are not normally distributed. To test for differences between two samples, a t-test is used. The t-test should fulfill the assumption of normality. Thus, to test for differences between the N-Gain Scores of the experimental class and the control class (using the lecture method) (Hypothesis point 3), as well as the post-test scores for self-efficacy of the experimental class (using the PjBL method) and the control class (using the lecture method) (Hypothesis point 5), a t-test can be applied. The results of the t-test are shown in the following table.

Table 8 The results of the t-test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SEPOST	Equal variances assumed	16.959	.000	6.120	53	.000	16.58333	2.70975	11.148	22.018
	Equal variances not assumed			6.050	37.347	.000	16.58333	2.74092	11.031	22.135
NGainScore	Equal variances assumed	26.060	.000	4.794	53	.000	28.63214	5.97239	16.653	40.611
	Equal variances not assumed			4.867	32.751	.000	28.63214	5.88331	16.658	40.605

The p-value for the t-test on N-Gain Score data is 0.000, both assuming equal variances between the two samples and assuming unequal variances. Thus, at a 5% significance level, there is a difference between the N-Gain Scores of the experimental class (using the PjBL method) and the N-Gain Scores of the control class (using the lecture method), rejecting the null hypothesis for Hypothesis point 3. This implies that the treatment given to the experimental class using PjBL and the control class using the lecture model yielded different improvements in concept mastery. This is consistent with the average N-Gain Scores of the experimental and control classes, with a difference of about 0.29. The N-Gain Score of the experimental class is higher compared to the control class. The p-value for the t-test on self-efficacy scores is 0.000, both assuming equal variances and assuming unequal variances. Thus, at a 5% significance level, there is a difference between the post-test self-efficacy scores of the experimental class and the control class, rejecting the null hypothesis for Hypothesis point 5. This means that the instructional treatment of the experimental class using PjBL and the control class using the lecture model yielded different levels of self-confidence to students. This is consistent with the average post-test self-efficacy scores of the experimental and control classes, with a difference of about 16.58. The post-test self-efficacy score of the experimental class is higher compared to the control class. To test for differences between two samples, the Mann Whitney U test can be used. The Mann Whitney U test does not require the assumption of normality. Therefore, the Mann Whitney U test can be used to test hypotheses 1, 2, 4, 6, and 7. The results of the Mann Whitney U test are as follows.

Table 9 Results of the Mann Whitney U test

Results of the Mann Whitney U test

Test Statistics[a]

	CMPRE	CMPOST	SEPRE	COLLABPRE	COLLABPOST
Mann-Whitney U	352.000	142.500	284.000	348.000	244.500
Wilcoxon W	730.000	520.500	690.000	754.000	622.500
Z	-.439	-3.984	-1.586	-.508	-2.258
Asymp. Sig. (2-tailed)	.661	.000	.113	.612	.024

a. Grouping Variable: Kelompok

For the data of pre-test concept mastery scores, the p-value from the Mann Whitney U test is 0.661. Therefore, at a 5% significance level, there is no difference between the pre-test concept mastery scores of the experimental class and the control class, accepting the null hypothesis for Hypothesis point 1. This indicates that before the implementation of PjBL in the experimental class and the lecture model in the control class, students' concept mastery abilities in both classes were relatively similar. For the data of post-test concept mastery scores, the p-value from the Mann Whitney U test is 0.000. Thus, at a 5% significance level, there is a difference between the post-test concept mastery scores of the experimental class and the control class, rejecting the null hypothesis for Hypothesis point 2. This means that the PjBL treatment in the experimental class and the lecture treatment in the control class resulted in different levels of concept mastery. For the data of pre-test self-efficacy scores, the p-value from the Mann Whitney U test is 0.113, indicating that there is no difference between the pre-test self-efficacy scores of the experimental class and the control class, accepting the null hypothesis for Hypothesis point 4. Thus, the PjBL treatment in the experimental class and the lecture treatment in the control class yielded relatively similar self-confidence attitudes in both classes. For the data of pre-test collaboration scores, the p-value from the Mann Whitney U test is 0.612. Therefore, at a 5% significance level, there is no difference between the pre-test collaboration scores of the experimental class and the control class, accepting the null hypothesis for Hypothesis point 6. This indicates that the PjBL treatment in the experimental class and the lecture treatment in the control class resulted in similar collaboration skills in both classes. For the data of post-test collaboration scores, the p-value from the Mann Whitney U test is 0.024. Thus, at a 5% significance level, there is a difference between the post-test collaboration scores of the experimental class and the control class, rejecting the null hypothesis for Hypothesis point 7. This means that the PjBL treatment in the experimental class and the control class resulted in different collaboration abilities.

DISCUSSION

From the results of data description, data testing, and data analysis, it can be concluded that the PjBL treatment in the experimental class and the lecture treatment in the control class yielded different outcomes in students' collaboration skills. The post-test collaboration scores of the experimental class were higher compared to the control class. This implies that the treatments applied in the experimental and control classes resulted in distinct improvements in students' collaboration abilities.

In terms of the average N-Gain for the experimental class, which had an average N-Gain score of 0.47, it can be inferred that before and after implementing the PjBL method, there was a moderate improvement in concept mastery. This increase in N-Gain can be attributed to the fact that prior to the research, Class VII at SMP XYZ had frequently utilized Project-Based Learning (PjBL) methods. On the other hand, the control class had an average N-Gain of 0.18, indicating a low level of concept mastery improvement before and after the lecture method was employed. This lower increase in N-Gain for the control class can be attributed to the infrequent use of lecture-based teaching methods in Class VII at SMP XYZ.

Furthermore, the N-Gain score of the experimental class was higher than that of the control class. This suggests that the treatment applied in the experimental and control classes led to distinct enhancements in students' self-efficacy. The post-test self-efficacy scores of the experimental class were higher than those of the control class. This outcome implies that prior to the implementation of the treatment, the experimental and control classes had relatively similar self-efficacy levels. The treatment, however, resulted in different levels of self-efficacy beliefs between the two classes. The findings also indicated that the PjBL method in the experimental class and the lecture method in the control class led to varying levels of concept mastery. The post-test scores of the experimental class were higher than those of the control class, indicating that the treatments resulted in different outcomes in students' ability to collaborate.

In the control class, the average pre-test score was 116.37, and after the lecture-based treatment, the average score decreased to 102.96. This decline can be attributed to the nature of lecture-based teaching, which limits opportunities for students to engage in collaboration. In lecture-based teaching, the learning activities are more teacher-centered, and students have limited participation in group activities and collaboration with their peers.

CONCLUSION

Based on the data processing and analysis conducted, the following are the conclusions drawn from this research:

1. There is no significant difference between the pre-test concept mastery scores of the experimental class and the control class.
2. There is a significant difference between the post-test concept mastery scores of the experimental class and the control class.
3. There is a significant difference between the N-Gain scores of the experimental class and the control class. The average N-Gain score of the experimental class is 0.47, indicating a moderate level of improvement in concept mastery before and after using the PjBL method. The average N-Gain score of the control class is 0.18, indicating a low level of improvement in concept mastery before and after using the lecture method.
4. There is no significant difference between the pre-test self-efficacy scores of the experimental class and the control class.
5. There is a significant difference between the post-test self-efficacy scores of the experimental class and the control class. The average post-test self-efficacy score of the experimental class is 130.25, while the average post-test self-efficacy score of the control class is 113.67. The difference between the post-test scores of the experimental and control groups is 16.58, indicating that the treatment had a different effect on the self-efficacy beliefs of the students.
6. There is no significant difference between the pre-test collaboration scores of the experimental class and the control class.

7. There is a significant difference between the post-test collaboration scores of the experimental class and the control class.

In summary, the results of this research indicate that the application of the PjBL method in the experimental class and the lecture method in the control class led to different outcomes in terms of concept mastery, self-efficacy, and collaboration skills. The experimental class showed higher post-test scores in concept mastery, self-efficacy, and collaboration compared to the control class. The N-Gain scores further supported the positive impact of the PjBL method on concept mastery. The findings emphasize the effectiveness of the PjBL method in enhancing students' concept mastery, self-efficacy, and collaboration skills.

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