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Student Learning Model Enhancement: How Does the Project-Based Learning Model Affect Students' Critical Thinking Skills?

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Abstract: This study explores the influence of project-based Learning Models on critical thinking. Project-based Learning makes a significant contribution to developing students' critical thinking skills. Students involved in PJBL tend to be more active in the learning process, can ask in-depth questions, and have the ability to analyze and reflect on information critically. The research used a quantitative approach with a survey method. Respondents in this study were elementary school students. The research population was 47 students, obtained through the proportional random sampling technique—respondents of elementary school students in the 2024 academic year. The study results showed a significant favorable influence between Project Learning and students' Critical Thinking with a t count of 72.0 and a significance value (p) of 0.000 <0.05. From the simple regression analysis calculation results, the R Square value was 28.0. Project Learning affects critical Thinking by 72.0%, and other factors influence the remaining 28.0%.

Keywords: Project-based Learning; Critical Thinking; Learning Models; Strategies.

1. Introduction

In the era of increasingly advanced globalization, where technology and information are developing very rapidly, critical thinking skills are a very needed competency. Globalization brings changes in how we communicate and work, broadens the horizons of knowledge, and presents increasingly complex challenges. Critical thinking skills are crucial to managing abundant and often unverified information in this context. Critical thinking is not just a skill but also a rational and wise process that uses logical reasoning to decide what to believe and do. This process involves conceptualizing, applying, analyzing, synthesizing, and evaluating information obtained through observation, experience, and reflection. In this way, critical thinking becomes the basis for making the right decisions. Furthermore, critical thinking demands interpretation, analysis, and evaluation of information based on clear evidence, proven methods, and contextual considerations to reach reasonable, in-depth conclusions facing global dynamics[1]. In the *Brahmayu Sutta*, the Buddha gives gradual teachings to the Brahmin *Brahmayu*, starting with a discourse on giving, morality, and the heavenly realms. He also explains the dangers and defilements of sensual pleasures and the benefits of renunciation. After

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the Brahmayu is mentally prepared, the Buddha expounds the essential teachings of the Buddhas: suffering, its origin, its cessation, and the path leading to its cessation. Upon hearing this teaching, the *Brahmayu* attains a profound understanding of the Dhamma, realizing that everything that arises is subject to cessation. He casts aside doubt, gains confidence, and no longer relies on others for the Buddha's teachings. In Indonesia, implementing Project Based Learning aligns with the national education goals stipulated in the National Education System Law No. 20 of 2003. This law emphasizes the importance of creating a learning atmosphere that allows students to actively participate in developing their potential(Azizah, 2023).Implementing Project Based Learning is expected to create a more interactive and relevant learning environment, supporting the development of students' critical and creative thinking skills.

In the *Canki Sutta*, The Buddha taught not to jump to conclusions based on appearances or limited information. A hermit named *Canki* doubted the Buddha's teachings simply because of the Buddha's simple physical appearance. The Buddha emphasized that judgments of teachings should be based on substance, not physical aspects or social status. Teachings should be tested and thoroughly investigated to determine their usefulness, morality, and consistency with personal experience. The main message of this sutta is the importance of wise evaluation through deep study, not superficial judgment (Sutta, nd). Education has a central role in developing critical thinking skills in students. Suhartini (2021)reveals that a supportive educational environment and effective learning methods are essential to facilitate the development of these skills. Quality education should be able to teach students not only academic material but also thinking skills that can be applied in various life situations. With learning methods that support the development of critical thinking skills, students can learn how to analyze information, evaluate arguments, and solve problems systematically. The concept of critical thinking in Buddhism can be seen in the *sampasadaniya* and *kalama* sutta.

In the *Sampasadaniya Sutta*, the Buddha teaches the importance of examining and understanding teachings through practical experience and results in everyday life. This shows that critical thinking involves in-depth evaluation and application of proven principles. Meanwhile, in the *Kalama Sutta*, the Buddha advises the *Kalamas* to use essential judgment and not accept teachings without consideration. Both suttas emphasize the importance of reflection and evaluation in Learning and decision-making. An educational approach focusing on memorizing information and developing thinking skills will prepare students to become active and reflective learners. One of the practical learning models for developing critical thinking skills is Project Based Learning. Project-based Learning is an approach that focuses on completing complex projects and challenges students to work collaboratively to find solutions [5], [6]. In this model, students learn theory and apply knowledge in authentic contexts through relevant and applicable projects.

In the *Kesaputtiya Sutta*, the Buddha acknowledges that it is natural for the *Kālāmas* to feel doubtful and confused about confusing teachings. The Buddha advises them not to accept teachings based on oral tradition, hearsay, logic, reasoning, or faith in a teacher.

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Instead, they should evaluate the teachings through personal experience. If they know that something is unwholesome, blameworthy, and leads to harm and suffering, then they should abandon it. The Buddha emphasizes the importance of critical judgment and direct experience in determining the truth of a teaching. Project Based Learning allows students to be actively involved in the learning process in a more exciting and challenging way. This model supports the development of critical thinking skills because students must analyze problems, plan and implement projects, and evaluate the results [7]. It shows that Project Learning can increase student engagement, motivation, and critical thinking skills more effectively than traditional learning methods. By implementing Project Based Learning, students can learn how to apply the knowledge they have learned in more practical and relevant situations.

In the Kalama Sutta, the Buddha teaches that one should not accept teachings based on authority, tradition, or hearsay but should investigate and test them through reason and personal experience. The Buddha emphasizes that teachings should be evaluated based on morality, positive results, and consistency with personal experience. This approach emphasizes the importance of critical and rational thinking and allows individuals to choose teachings that they consider correct after thorough investigation. Thus, the Kalama Sutta underscores the significance of passively accepting information and actively evaluating and testing it with logic and experience, which is the basis for a critical approach to information and belief.

According to the Partnership for 21st Century Skills, critical thinking is among the fundamental skills needed to meet the challenges of postsecondary education and the workforce. This emphasis reflects the need to prepare students with the analytical and evaluative skills required in various situations, both in academic and professional settings [8]. Critical thinking involves analyzing and evaluating information, constructing solid arguments, and considering multiple perspectives before reaching a rational and accountable final decision.[9]. Project Based Learning involves students in complex, real-life, task-based projects. By following this approach, students gain theoretical knowledge and develop critical thinking skills through applying knowledge in practical contexts. Projects in Project Based Learning encourage students to work collaboratively, solve problems, and create innovative solutions. In this way, students can develop problem-solving and critical thinking skills that are essential for their future academic and professional success [10], [11], [12]

By prioritizing developing critical thinking skills in the education system, we can prepare students for success in their careers and personal lives and help them face the demands of a changing world more effectively. With the right approach in education and teaching methods, such as Project Based Learning, critical thinking skills can be developed to their full potential to prepare young people to face global and local challenges in the future [13]. The characteristics of critical thinking include (1) being able to distinguish between relevant and irrelevant ideas, (2) being able to detect bias or deviations, (3) being able to list all possible consequences or alternative solutions to problems, (4) being able to conclude existing and selected data, (5) being able to test assumptions carefully, and (6) being able to make sequential connections between one

problem and another [14]. This approach emphasizes Learning that involves long-term activities where students are actively engaged in the learning process [15], [16]. The tasks in Project Based Learning are multidisciplinary and product-oriented, allowing students to integrate knowledge from various fields. Thus, Project-based Learning facilitates more meaningful and relevant learning because students learn theory and apply it in natural contexts [17], [18].

In this approach, students work collaboratively to investigate and find solutions to real problems relevant to their lives, encouraging them to think critically, creatively, and innovatively. Students are involved in gathering information, analyzing data, and developing products or solutions that allow them to apply the theories learned in real-world contexts. Thus, Project Learning strengthens students' understanding and helps them develop essential skills in their future lives and careers [19], [20]. Implementing the Project Based Learning (PJBL) method aims to provide students with in-depth insight when facing problems directly and develop critical thinking skills in solving these problems. With this method, students gain theoretical knowledge and learn to apply it in authentic contexts, improving their ability to analyze, evaluate, and synthesize information. Project Learning aims to hone students' critical thinking skills and broaden their horizons through practical experience in facing and solving problems [21].

2. Method

This study uses a survey method with a descriptive quantitative approach to evaluate the effect of the project-based learning model on students' critical thinking skills. The descriptive quantitative data analysis method is a method that helps describe, present, or summarize data constructively, provides specific summary data samples, and, by recognizing patterns, reveals more details about the data [22]. Data were collected through a questionnaire that measured students' critical thinking skills before and after implementing project-based Learning. The analysis used descriptive statistical techniques to describe the results and impacts of project-based Learning. This method provides a clear and objective picture of the effectiveness of project-based Learning in improving students' critical thinking skills and supporting improvements in learning practices.

3. Results

Based on the test instrument of the influence of the project-based learning model on students' critical thinking skills, it was obtained that out of 60 items, there were 30 project-based learning variable items and 30 essential thinking variable items. The results for the project-based learning variable contained 27 valid items and three invalid items, while for the critical thinking variable, there were 30 valid items. Several of these items were declared invalid by comparing the r_{table} on 47 respondents with a significance level of 0.05, namely 0.344. If $r_{count} < r_{table}$, then the items are declared invalid. The researcher removed the invalid statement items so that out of 60 statement items, there were still 57. Based on the reliability test of the research instrument, the reliability statistics obtained using SPSS 26.0 produced a Cronbach Alpha value of 0.972 because the significance

value> 0.05 means that the measuring instrument is declared reliable. It can be concluded that the research instrument used in this study met the requirements and was dependable.

Table 1. Reliability Test

Reliability Statistics	
Cronbach's Alpha	Based on Standardized Items N of Items
,972	,973 57

(Source: 2024 research data processing using SPPS 26.0)

Normality Test

It aims to test whether the residual value obtained has a normal distribution. If the significance value> 0.05, then it can be said that the residual value is usually distributed, and if the significance value <0.05, then it can be said that the residual value is not normally distributed. The normality test in this study uses the help of IBM SPSS 26 software using the One-Sample Kolmogorov Smirnov test, with a significance level of 0.05 or 5%. A significance level of 0.05 or 5% means that researchers risk making mistakes in rejecting the correct hypothesis as much as 5% and are accurate in deciding at least 95%, the same; the error rate, the better the research. The results of the normality calculation using the One-Sample Kolmogorov-Smirnov test are presented in the following table.

Table 2. Normality Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		47
Normal Parametersa,b	Mean	,0000000
	Std. Deviation	8.36854652
Most Extreme Differences	Absolute	,089
	Positive	,076
	Negative	-,089
Test Statistics		,089
Asymp. Sig. (2-tailed)		,200c,d

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

(Source: 2024 research data processing using SPPS 26.0)

Homogeneity Test

The homogeneity test is intended to show that two or more sample data groups come from populations with the same variance. The homogeneity test uses the Compare Means One-way Anova test. The requirement for homogeneity variance is if the test criteria are more than 0.05 or 5%. Based on the results of the homogeneity test from the Output Test of Homogeneity of Variances, it is known that the significance value of 0.476 ≥ 0.05 means that the project-based Learning and critical thinking data are homogeneous. Thus,

it can be concluded that the variance of the two groups is homogeneous. The results of the homogeneity calculation using the Compare Means One Way Anova test are presented in the following table:

Table 3. Homogeneity Test

Test of Homogeneity of Variances					
		Levene Statistics	df1	df2	Sig.
PJBL	Based on Mean	1,529	1	92	,219
	Based on Median	1,558	1	92	,215
	Based on the Median and with adjusted df	1,558	1	90,008	,215
	Based on trimmed mean	1,529	1	92	,219

(Source: 2024 research data processing using SPPS 26.0)

Hypothesis Testing and Simple Linear Regression Analysis

Based on the output results by reading the coefficients, a constant value of 7.068 was obtained, which means that if project-based Learning (X) has a value of 0, then critical thinking (Y) has a positive value of 7.068. The regression coefficient on the project-based learning variable (X) is 1.026, meaning that if project-based Learning experiences an increase or development, the critical thinking variable (Y) will experience an increase of 1.026. For further details, please see the following coefficients table.

Table 4. Regression Equation Output

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	7,068	9,789		,722	,474
	PJBL	1,026	,095	,848	10,751	,000
a. Dependent Variable: Critical Thinking						

(Source: 2024 research data processing using SPPS 26.0)

Based on the Anova output, the calculated F value is 115.580 and significant 0.000, so there is no need to match it with the F table because SPSS has facilitated it with substantial values. The implementation of the results obtained is significant at 0.000 <5%, meaning H0 is rejected and Ha is accepted. This means that project-based Learning affects critical thinking.

Table 5. Anova Analysis Output

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8274,204	1	8274,204	115,580	,000b
	Residual	3221,498	45	71,589		
	Total	11495,702	46			

a. Dependent Variable: Critical Thinking
b. Predictors: (Constant), PJBL
(Source: 2024 research data processing using SPPS 26.0)

The coefficient of determination in the table above is R Square, which has a value of 0.720, meaning that 72.0% of mindfulness practices affect students' academic procrastination, while other variables influence the remaining 28.0%.

Table 6. Value of Determination Coefficient R Square

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,848a	,720	,714	8,461

a. Predictors: (Constant), PJBL
b. Dependent Variable: Critical Thinking
(Source: 2024 research data processing using SPPS 26.0)

Based on the results of data analysis, there is a significant influence between project-based Learning and students' critical thinking. It can be seen from several pieces of evidence that have been carried out through research results in questionnaires and analyzed from each variable to obtain an analysis result that can be tested and accounted for its truth. Thus, it can be used to make decisions and conclusions about the research. The above results align with research conducted by Thomas Markham (2020) in his article entitled "Project-Based Learning: A Bridge Just Far Enough", which found that PJBL is positively related to students' critical thinking skills. Markham explained that PJBL develops students' ability to solve problems, analyze information critically, and reflect on their learning process. The correlation between PJBL and critical thinking skills is also supported by research results showing that students involved in PJBL tend to have a deeper understanding of the subject matter and can apply it in context

Another study that strengthens this finding is by Larmer and Mergendoller (2020) in an article entitled "Seven Essentials for Project-Based Learning." The study shows that using PJBL effectively can improve students' critical thinking skills by providing authentic challenges that encourage them to think analytically and creatively. This is supported by the results of the t-test, which shows that the implementation of PJBL significantly affects students' critical thinking skills, with a t-count of 72.0, more significant than the t-table of 28.0, which means the hypothesis is accepted. This study is also consistent with other studies conducted by Oktavia and Santosa (2021), which examined "The Effect of Project Learning on Critical Thinking Skills of Elementary School Students." Their analysis showed that PJBL positively affected students' critical thinking skills, as indicated by increased students' abilities in constructing arguments, disseminating information, and interspersing. Research conducted at Plus Manjushri School also shows that teachers who implement PJBL by providing projects relevant to Buddhist lessons, such as applying Buddhist teachings in everyday life, help students hone their critical thinking skills. PJBL emphasizes deep and meaningful learning

experiences, where students are invited to solve real problems, collaborate, and reflect on their learning process, all of which are integral parts.

Overall, the findings of this study indicate that the Project Based Learning learning model significantly contributes to improving Buddhist students' critical thinking skills. Students involved in PJBL tend to be more active in the learning process, can ask more profound questions, and have the ability to listen and reflect on information critically. This supports the implementation of PJBL as a practical learning approach to developing critical thinking skills. This is proven by the results of the t-test, which shows a t-count of 72.0, which is greater than the t-table of 28.0, which means that the hypothesis is accepted that PJBL significantly influences students' critical thinking skills. This study is also consistent with the study conducted by Oktavia and Santosa (2023), which examined "The Effect of Project Based Learning on Critical Thinking Skills of Elementary School Students." They found that PJBL positively improved critical thinking skills, especially in terms of student's ability to formulate arguments, disseminate information, and analyze situations. This study confirms that the Project Based Learning model significantly contributes to developing students' critical thinking skills. Students involved in PJBL tend to be more active in the learning process, can ask in-depth questions, and have the ability to analyze and reflect on information critically. These findings support the implementation of PJBL as a practical learning approach to improving critical thinking skills among students, especially in Elementary Schools.

4. Conclusion

Based on the results of the study on the influence of Project Learning on critical thinking skills of Buddhist students (case study in Elementary School), it can be concluded that there is a significant favorable influence between the implementation of Project Based Learning on critical thinking skills of Buddhist students in Elementary School. This learning model can improve students' abilities in analyzing, evaluating, and solving problems more effectively. The magnitude of the influence of Project Learning on students' critical thinking skills can be seen from the R Square value, which shows that the implementation of PJBL influences 71.4% of the increase in students' critical thinking skills, while 28.6% is influenced by other factors not examined in this study.

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