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THE EFFECT OF PROJECT-BASED LEARNING ON STUDENTS' ANALYTICAL THINKING ABILITY AND CREATIVITY AT ENSINO BÁSICO CENTRAL 3º CICLO PALAKA MALIANA

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A B S T R A C T

This study aims to develop interactive flipbook-based *IPAS* e-modules integrating local wisdom and evaluate their implementation in fifth-grade elementary education to address challenges like teacher-centered methods and low student engagement. Employing a qualitative descriptive design at SDN Grati 1 Pasuruan, data were collected through observation, interviews, and documentation, then analyzed using the Miles, Huberman, and Saldaña interactive model. The results indicate that e-modules integrating the *Larung Sesaji* tradition of Lake Ranu Grati deliver contextual, interactive, and participatory learning. This digital teaching material successfully increased student engagement and enhanced their understanding of local wisdom as part of their social identity. Consequently, these e-modules serve as an effective alternative for culture-based *IPAS* instruction in elementary schools.

INTRODUCTION

The development of 21st-century education requires students to possess higher-order thinking skills, particularly analytical thinking and creativity. Liline

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et al. (2024) demonstrated that analytical and creative thinking skills are essential components of Higher-Order Thinking Skills (HOTS) that need to be developed through innovative learning models, enabling students to understand concepts more deeply and compete in the global era. Lubis et al. (2024) emphasised that the Project-Based Learning (PjBL) model has been proven effective in developing 21st-century skills in the classroom, including critical thinking, collaboration, and creativity, which are essential demands of modern education. (Rehman et al., 2024) further supported these findings by demonstrating, through structural equation modelling, that PjBL significantly improves critical thinking skills, problem-solving abilities, and students' active engagement in 21st-century learning (A. Da Costa, 2026).

The reality in schools indicates that learning at the junior secondary school level is still dominated by conventional teacher-centred methods, causing students to become passive and less actively involved in the learning process. Purba et al. (2022) stated that conventional methods have been shown to be less effective in improving students' critical and analytical thinking skills at EBC 3<u>0</u> Ciclo, as learning tends to focus more on theoretical knowledge acquisition, without providing opportunities to develop higher-order thinking skills. Faizah et al. (2022)found that limited student activities and engagement in conventional learning directly affect students' low problem-solving abilities, which represent an important indicator of analytical thinking skills. Arlinda et al. (2022) further noted that the lack of innovation in the learning models implemented by teachers directly contributes to the decline in students' creativity, highlighting the need for a shift toward more active, innovative learning approaches.

One of the learning models that can address these problems is Project-Based Learning (PjBL), which places students at the centre of learning through project activities involving investigation, problem-solving, collaboration, and the creation of authentic products. (Chusni, 2023), Through a meta-analysis of 25 journals, researchers concluded that PjBL contributed 88% to critical thinking skills and 82% to students' creative abilities, demonstrating that PjBL is an effective model for enhancing 21st-century skills. (Hsiao et al., 2022) proved that the implementation of PjBL among EBC 3<u>0</u> Ciclo students significantly improved knowledge, creativity, and academic performance through direct learning experiences that integrate investigation and product creation. (Rehman et al., 2024) confirmed that PjBL has a significant positive impact on students' analytical abilities and critical thinking skills while simultaneously increasing motivation and active

engagement in the project-based learning process.

PjBL provides more meaningful learning experiences by connecting learning materials to real-life contexts, making the learning process more contextual, engaging, and relevant to students as they develop creative ideas. Zhao & Wang (2022), through a meta-analysis of 66 experimental studies conducted over 20 years, confirmed that compared with traditional learning models, PjBL significantly improves students' learning outcomes, affective attitudes, and thinking skills across various learning contexts. Fitri et al. (2024), in a systematic literature review, demonstrated that PjBL is an effective solution for enhancing students' creativity by encouraging them to think contextually, produce original products, and develop innovative ideas to solve real-world problems. Lavli and Efendi (2023)found that the consistent and structured implementation of PjBL effectively improves creative thinking skills among junior secondary school students, with significant improvements in fluency, flexibility, and originality of thinking.

Analytical thinking ability refers to the ability to analyse, understand, and evaluate a problem systematically and logically, while creativity refers to the ability to generate new, original, and valuable ideas. Liline et al. (2024) empirically demonstrated that the PjBL model integrated with HOTS-based learning significantly influenced analytical thinking ability ($p = 0.000 < \alpha = 0.05$) and creative thinking ability ($p = 0.001 < \alpha = 0.05$) among biology students, indicating that these two abilities should be developed in an integrated manner. Zhao & Wang (2022) explained that analytical ability is essential for understanding complex concepts and supporting rational decision-making; therefore, students with high analytical abilities are better able to overcome challenges in project-based learning contexts. Wiyanti & Hadi (2023) stated that both analytical thinking and creativity can be optimally developed through the implementation of project-based learning models that emphasise product creation activities and independent exploration of ideas .

Although various studies have demonstrated the effectiveness of PjBL, most previous research has examined analytical thinking and creativity variables separately, leaving a research gap that needs to be addressed. (Chusni, 2023) In his meta-analysis, he explicitly highlighted that studies simultaneously examining the effect of PjBL on critical and creative thinking skills remain limited; therefore, further research integrating these two variables within a comprehensive research design is needed. Zhang & Ma (2023) emphasised the need for more experimental and quasi-experimental studies across

diverse real-world contexts to strengthen empirical evidence on the effectiveness of PjBL, particularly in areas with limited educational resources, such as remote regions. Lubis et al. (2024)further stated that research on the implementation of PjBL in developing countries and remote areas remains scarce; thus, investigating PjBL at EBC 30 Ciclo Maliana is highly relevant and important for addressing this research gap.

The novelty of this study lies in examining the effect of PjBL on two variables simultaneously, namely analytical thinking ability and creativity, within an integrated research design conducted at EBC 30 Ciclo Palaka Maliana, Timor-Leste. Fajri et al. (2023) and Wastiani et al. (2023) emphasised that studies combining critical and creative thinking within a single quasi-experimental design remain limited; therefore, integrated research of this nature provides meaningful methodological contributions to the development of educational science. Sari et al. (2026) further highlighted the importance of innovative PjBL-based research by demonstrating that an integrated STEAM project-based learning approach significantly improves creative thinking skills, further supporting the relevance of PjBL in modern educational contexts. Rehman et al.(2024) confirmed that PjBL research conducted in secondary schools using quasi-experimental designs and inferential statistical analyses provides strong empirical evidence; thus, the approach employed in this study is appropriate for measuring the effectiveness of PjBL in a remote educational context such as EBC 30 Ciclo Palaka Maliana.

METHOD

This study employed a quantitative approach with a pre-experimental one-group pretest–posttest design to examine the effect of implementing the Project-Based Learning (PjBL) model on students' analytical thinking skills and creativity in Natural Sciences learning at Ensino Básico Central 30 Ciclo (EBC 30 C). This design involved a single group that was administered a test before (*pretest*) and after (*posttest*) the implementation of the PjBL model, allowing changes that occurred after the treatment to be directly observed Creswell, J. W., & Creswell, 2023)

The study population consisted of all seventh-grade students at EBC 30 Ciclo, totalling 30 students. Due to the relatively small population, a total sampling approach was used, selecting the entire population as the research sample.

The independent variable in this study was the PjBL learning model, while the dependent variables were students' creativity and analytical thinking skills. Students' creativity was measured using a Likert-scale questionnaire consisting of indicators of

fluency, flexibility, originality, and elaboration. Students' analytical thinking skills were measured using a written essay test developed based on indicators of problem analysis, information evaluation, and logical conclusion-making within the context of Natural Sciences learning.

The research procedure consisted of three stages: (1) administering a pretest to measure students' analytical thinking skills and creativity before the treatment, (2) implementing Natural Sciences learning using the PjBL model through project planning, project implementation, and presentation of results, and (3) administering a posttest to measure changes in students' analytical thinking skills and creativity after the treatment.

Data analysis was conducted using descriptive and inferential statistics. Descriptive statistics were used to describe the mean scores of the pretest and posttest. Before hypothesis testing, a normality test was performed to ensure that the data met the assumptions of parametric analysis. Hypothesis testing was conducted using a paired-samples t-test at the 0.05 significance level to determine differences in scores before and after implementing the PjBL model. Regression analysis was not applied in this study; therefore, it was not included in the data analysis.

RESULT AND DISCUSSIONS

Result

This study examined the effect of the Project-Based Learning (PjBL) model on students' creativity and analytical thinking skills through pretest and posttest measurements. The pretest was conducted to assess students' initial abilities before the treatment, while the posttest was administered to determine changes in their abilities after participating in project-based learning activities. The collected data were analysed using descriptive statistics to compare students' performance before and after the implementation of PjBL. The results of the analysis are presented according to the two research variables: creativity and analytical thinking skills. The descriptive statistics for students' creativity scores are presented in Table 1.

			Statistik	Std.Error
Pretest Creativity	Mean		50.52	0.992
	95% Confidence Interval for mean	Lower Bound	48.48	
		Upper Bound	52.56	
	5% Trimmed Mean		50.49	
	Median		50.00	
	Variance		26.567	
	Std. Deviation		5.154	
	Minimum		41	
	Maximum		60	
	Range		19	
	Interquartile Range		6	
	Skewness		0.321	0.448
	Kurtosis		-0.338	0.872
Posttest Creativity	Mean		71.44	0.989
	95% Confidence for Mean I	Lower Bound	69.41	-
		Upper Bound	73.48	-
	5% Trimmed Mean		71.53	-
	Median		70.00	-
	Variance		26.410	-
	Std. Deviation		5.139	-
	Minimum		60	-
	Maximum		80	-
	Range		20	-
	Interquartile Range		7	-
	Skewness		0.075	0.448
	Kurtosis		-0.407	0.872

Table 1. Descriptive Statistics of Creativity

Based on the descriptive statistics results, the mean creativity pretest score was 50.52 with a standard deviation of 5.154. The minimum score was 41, while the maximum score was 60. After implementing PjBL, the mean posttest score increased to 71.44, with a standard deviation of 5.139. The minimum posttest score was 60, and the maximum score was 80. This increase in the mean score indicates an improvement in students' creativity following the implementation of the PjBL learning model.

Furthermore, the skewness and kurtosis values for both the pretest and posttest were within the range of −1 to +1, indicating that the data were normally distributed.

Table 2 Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Creativity	0.133	27	0.200*	0.951	27	0.228
Posttest Creativity	0.203	27	0.006	0.943	27	0.143

Table 2. Tests of Normality

* This is a lower bound of the true significance.
a.Lilliefors Significance Correction

The Shapiro–Wilk normality test results showed that the significance values for the creativity pretest and posttest were 0.228 and 0.143, respectively. Since the significance values of both datasets were greater than 0.05 (Sig. > 0.05), the pretest and posttest creativity data were normally distributed (Brito & da Costa, 2024). Therefore, the data met the assumptions required for parametric testing using the Paired Samples t-Test.

Pretest Analytical Thinking Skills	Mean		48.44	1.010
	95% Confidence Interval for mean	Lower Bound	46.37	
		Upper Bound	50.52	
	5% Trimmed Mean		48.31	
	Median		48.00	
	Variance		27.564	
	Std. Deviation		5.250	
	Minimum		40	
	Maximum		59	
	Range		19	
	Interquartile Range		7	
	Skewness		0.522	0.448
	Kurtosis		-0.260	0.872
Posttest Analytical Thinking Skills	Mean		71.33	1.126
	95% Confidence for Mean I	Lower Bound	69.01	-
		Upper Bound	73.65	-
	5% Trimmed Mean		71.52	-
	Median		70.00	-
	Variance		34.385	-
	Std. Deviation		5.864	-
	Minimum		59	-
	Maximum		80	-

	Range	21	-
	Interquartile Range	7	-
	Skewness	0.459	0.448
	Kurtosis	-0.131	0.872

Table 3. Descriptive Statistics of Analytical Thinking Skills

Based on the descriptive statistics, the mean pretest score for students' analytical thinking skills was 48.44, with a standard deviation of 5.250. The minimum score was 40, while the maximum score was 59. After implementing PjBL, the mean posttest score increased to 71.33, with a standard deviation of 5.864. The minimum posttest score was 59, and the maximum score was 80. This increase in the mean score indicates an improvement in students' analytical thinking skills after the implementation of the PjBL learning model.

The skewness and kurtosis values of the pretest and posttest data were also within the normal range, indicating that the data were normally distributed.

Tests of Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Pretest analytical thinking skills	0.152	27	0.114	0.940	27	0.125
Posttest analytical thinking skills	0.145	27	0.148	0.930	27	0.069

Table 4. Tests of Normality

a.Lilliefors Significance Correction

The Shapiro–Wilk normality test results showed that the pretest significance value for analytical thinking skills was 0.125, while the posttest significance value was 0.069. Since the significance values were greater than 0.05, the analytical thinking skills data

were considered to be normally distributed. Therefore, the data met the requirements for conducting parametric tests.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest Creativity	20. 92 6.	.874	.168	21.272	20.580	124. 438	26	.000

Table 5. Paired Simple Test

Based on the Paired Samples Test results, the calculated t-value was 124.438 with a significance value (Sig. 2-tailed) of 0.000. Since the significance value was lower than 0.05 (0.000 < 0.05), H_0 was rejected, and H_1 was accepted. Therefore, it can be concluded that implementing PjBL significantly increased students' creativity.

The mean difference of 20.92 indicates that the average increase in students' creativity after implementing the PjBL model was 20.92 points.

		Paired Differences					t	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest Analytical Thinking Skills Posttest Analytical Thinking Skills	22. 889.	2.547	.490	21.881	23.897	46. 696	26	.000

Table 6. Paired Samples Test – Analytical Thinking Skills

The results of the Paired Samples t-Test for analytical thinking skills showed that the mean difference between the pretest and posttest scores was 22.889. The obtained t-value was 46.696 with df = 26 and a significance value of 0.000 (p < 0.05).

Since the significance value was lower than 0.05, H_0 was rejected, and H_1 was

accepted. Therefore, it can be concluded that there was a statistically significant difference between students' analytical thinking skills before and after the implementation of the Project-Based Learning (PjBL) model.

The increase in the mean score from 48.44 (pretest) to 71.33 (posttest) indicates that implementing the PjBL model significantly improved students' analytical thinking skills.

Discussions

The results of this study indicate that implementing the Project-Based Learning **(**PjBL**)** model has a positive effect on students' creativity and analytical thinking skills at the junior secondary school level. This is evidenced by increases in the mean pretest and posttest scores for both research variables following treatment with the PjBL model. The improvement demonstrates that PjBL can facilitate active learning through investigation, collaboration, discussion, and problem-solving. Students' direct involvement in the learning process enables them to construct knowledge through real-life experiences. This finding is consistent with constructivist theory, which states that knowledge is constructed through students' experiences and active interactions during the learning process. These findings also align with the study by Zulfia Novrita et al. (2024), which showed that PjBL can improve students' critical and creative thinking abilities.

Regarding the creativity variable, the results showed that the pretest mean score of 50.52 increased to 71.44 in the posttest after implementing the PjBL model. This improvement indicates that project-based learning can encourage students to generate ideas, develop concepts, and create creative learning products. Project activities provide students with opportunities to explore concepts, engage in discussions, collaborate, and solve given problems. These processes foster creativity because students are directly involved in designing and producing a product. This finding is supported by Handoko et al. (2022), who stated that implementing PjBL can improve students' creative thinking abilities.

The improvement in students' creativity is also related to the characteristics of PjBL, which provides opportunities for students to generate solutions and products based on real-world problems. Through the project stages, students are trained to

think flexibly, develop various alternative ideas, and evaluate their work outcomes. This condition indicates that PjBL not only improves conceptual understanding but also develops creative thinking abilities. Based on the theory of *experiential learning*, direct experience in completing projects helps students construct knowledge through the processes of trying, reflecting, and improving their work. This finding is consistent with the study by Oktaviani et al. (2024), which demonstrated that PjBL is effective in improving students' creative thinking skills.

The statistical analysis results showed that the creativity variable obtained a significance value of 0.000 in the Paired Samples t-Test, which was lower than 0.05 (0.000 < 0.05). Therefore, implementing the PjBL model significantly increased students' creativity. These results indicate that the improvement in creativity after project-based learning was statistically proven. Project activities involving planning, implementation, and evaluation provide opportunities for students to continuously develop creative thinking abilities. Thus, PjBL can create a learning environment that supports the emergence of students' ideas and innovations. This finding is supported by Adytia P and Zulyusri (2022), who stated that PjBL has a positive effect on students' creative thinking abilities.

Regarding analytical thinking skills, the results showed that the mean pretest score of 48.44 increased to 71.33 in the posttest after the implementation of the PjBL model. This improvement indicates that PjBL can enhance students' abilities to identify problems, analyse information, and determine solutions systematically. Project activities require students to conduct investigations, collect information, process data, and evaluate their work outcomes. These processes train students to apply higher-order thinking skills in solving problems. This finding is consistent with the study by Fajri et al. (2023), which demonstrated that PjBL can improve students' higher-order thinking skills.

Students' analytical thinking skills improved because PjBL provides opportunities to engage with real-world problems that require systematic thinking. In project-based learning, students not only acquire a theoretical understanding of concepts but also apply them to solve problems through project activities. The processes of analysing information, comparing various alternatives, and making decisions contribute to the development of students' analytical abilities. Learning

activities involving direct experiences encourage students to become more active in constructing their understanding. This finding is supported by Khairunnisa et al. (2024), who demonstrated that implementing PjBL can improve students' higher-order thinking skills.

The normality test results showed that all pretest and posttest data for both creativity and analytical thinking variables had p-values greater than 0.05, indicating that the data were normally distributed and met the assumptions for parametric testing. Furthermore, the results of the Paired Samples t-Test showed a significance value of 0.000 <0.05, indicating that the implementation of the PjBL model had a significant effect on students' creativity and analytical thinking skills. These results demonstrate that the changes in students' abilities after the implementation of PjBL were not random but were influenced by the project-based learning process used in the study.

Overall, the implementation of the PjBL model has been proven effective in improving junior secondary school students' creativity and analytical thinking skills. This success occurs because PjBL applies a student-centred learning approach through investigation, discussion, collaboration, and real-world problem-solving activities. This model provides learning experiences that enable students to connect theory with practice while developing 21st-century skills. The study by Sungkono, S., & Ekaputra (2023) showed that PjBL is effective in improving students' creativity and higher-order thinking skills. Furthermore, these findings are consistent with those of Lesman et al. (2023) and Shalihati et al. (2025), who found that PjBL has a positive impact on students' creativity, critical thinking skills, and learning outcomes.

CONCLUSIONS

Based on the results of the research entitled "The Effect of Project-Based Learning on Students' Analytical Thinking Ability and Creativity at Ensino Básico Central 30 Ciclo Palaka Maliana," it can be concluded that the implementation of the Project-Based Learning (PjBL) model has a significant effect on improving students' analytical thinking ability and creativity.

The findings showed that students' creativity improved after implementing PjBL. The mean creativity score increased from 50.52 in the pretest to 71.44 in the posttest, with a mean difference of 20.92 points. The results of the Paired Samples t-Test indicated a significance value of 0.000 ($p < 0.05$), indicating a statistically significant improvement in students' creativity after participating in project-based learning activities.

Furthermore, students' analytical thinking ability also increased significantly after the implementation of PjBL. The mean score improved from 48.44 in the pretest to 71.33 in the posttest, with a mean difference of 22.89 points. The Paired Samples t-Test results showed a significance value of 0.000 ($p < 0.05$), indicating that PjBL had a significant positive effect on students' analytical thinking ability.

Therefore, this study concludes that Project-Based Learning is an effective learning model for enhancing students' analytical thinking ability and creativity at Ensino Básico Central 30 Ciclo Palaka Maliana. Through project-based activities, students are encouraged to actively explore problems, generate creative ideas, analyse information, and develop solutions independently and collaboratively. Thus, PjBL can be considered an appropriate instructional approach to support the development of higher-order thinking skills and creativity among students.

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