

Enhancing Students' Critical Thinking Skills: The Impact of Project-Based and Task-Based Learning Across Motivation Levels

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ABSTRACT

Enhancing elementary students' critical thinking skills is a key educational objective. Instructional approaches such as Project-Based Learning (PjBL) and Task-Based Learning (TBL) are widely used, with their effectiveness potentially influenced by students' learning motivation. This quantitative study employed a quasi-experimental approach using a one-group pretest-posttest and a 2x3 factorial design without randomization. The sample consisted of 50 sixth-grade students from an elementary school in Bandung, Indonesia. Data were collected using critical thinking tests and learning motivation questionnaires. Statistical analyses were conducted to examine the effects of instructional methods and motivation levels. Students taught PjBL demonstrated higher average gains in critical thinking skills compared to those taught TBL. Both PjBL and TBL significantly improved students' critical thinking abilities. Additionally, learning motivation had a positive and significant effect on critical thinking outcomes across both instructional methods. Interaction effects indicated that the impact of each method varied depending on students' motivation levels. The findings suggest that while both PjBL and TBL are effective in fostering critical thinking, PjBL yields superior outcomes. Learning motivation plays a crucial role in maximizing the effectiveness of these instructional approaches. Therefore, integrating motivational strategies with appropriate pedagogical methods is essential to optimize students' critical thinking development.

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1. INTRODUCTION

The capacity for critical thought is needed in learning with the aim of influencing the problems students face in everyday life (Ridho et al., 2020). Therefore, students not only have high cognitive abilities but are also able to solve the problems they face. According to Ennis (Normadhita, 2018), critical thinking requires students to achieve the following indicators: a) asking questions, b) answering questions, c) drawing conclusions, d) expressing viewpoints or arguments, e) solving issues, and f) assessing and

evaluating the outcomes of critical evaluations. Therefore, the ability to think critically is skills that students must have. However, the importance of the ability to think critically is does not correspond to students' critical thinking skills in the field, as stated by Utami and Nurhadi, who found that only around 25% of elementary school students have critical thinking skills at a basic level, while most students are still at the stage of memorizing and remembering information. The findings of this investigation show that the learning methods used in schools are not enough to motivate pupils to use critical thought. Likewise, the findings of studies conducted by Rohmawati and Suryadi (2018) stated that this research was conducted in several elementary schools in West Java using a literacy-based critical thinking skills test. The results show that most students have difficulty interpreting information and making logical inferences from the texts they read. Their ability to analyze and evaluate information is very limited, which shows low critical thinking abilities. Based on the identification of this problem, it is necessary to make efforts to optimize Students' critical thinking abilities in grade 6 primary school.

Interestingly, in education in Indonesia, there are many gaps that create a distance between the desired competency targets and the results obtained. Conventional education patterns, which still focus on uniformity, the same physical characteristics, and the need to do things without comprehensive analysis, have contributed to forming a generation that is passive and uncreative. The lack of encouragement from educational patterns to stimulate students to think critically has given birth to a generation of 'followers' who only stand in queues, instead of appearing at the front and then becoming inventors to solve deadlocks or stop the flow of unproductivity that exists around them. There are many efforts that can be made, including choosing a model of learning that is thought to optimize critical thinking abilities. Of the many existing models, People who are believed to be able to maximize their critical thinking abilities include project-based learning and task-based models.

The PjBl model's implementation led to the selection of project-based learning, which indirectly directs students into learning that is closely related to real or contextual problems. Meanwhile, Task Based was chosen because the Task Based approach has many advantages in creating learning that is contextual, authentic, and in keeping with the 21st century's skill requirements. Based on the problems identified above, researchers have conducted research with the heading " The Effect of Project-Based and Task-Based Learning with Different Motivation Levels on Students' Critical Thinking Skills".

This research attempts to look at and describe the effects of project-based learning and task-based learning approaches with different levels of learning motivation on students' critical thinking abilities in science learning. Based on the background and research objectives, the study's research questions are: (1) What is the acquisition's description of critical thinking abilities for students who receive learning using the Project-Based Learning and Task-Based Learning models? (2) Does the Project-Based Learning model have a significant impact on pupils' development of critical thinking abilities? (3) Does the Task Based Learning model have a significant impact on pupils' development of critical thinking abilities? (4) Is there a difference in the influence of Project-Based Learning and Task-Based Learning on students' acquisition of critical thinking skills? (5) Is there a difference in the influence of students' level of learning motivation on students' acquisition of critical thinking abilities? (6) Do the task-based learning and project-based learning models have different effects on students' development of critical thinking abilities? (7) Is there an interaction effect between learning and the degree of motivation for instruction on developing pupils' capacity for critical thought? (8) Does the growth of students' critical thinking skills correlate well with their learning motivation scores? (9) Does student motivation score positively impact pupils' development of critical thinking abilities?.

2. METHODS

Given the study's objectives and questions, the method uses a sequential explanatory design and is quantitative. The explanatory sequential design flow is analyzed quantitatively first and then analyzed qualitatively. Descriptive statistics are used to determine the average score of students' mathematical thinking abilities, standard deviation, and the type of distribution. Inferential statistics are used in testing research hypotheses (Mertler et al., 2021). Data testing techniques using SPSS

application software (Mertler et al., 2021). The quantitative method used is a quasi-experimental method (Gall & Borg, 2014), with an experimental design, a one-group pretest-posttest design, and a 2 × 3 factorial design without randomization.

The population of this research is the score of acquisition and improvement of sixth-grade pupils' critical thinking abilities at one of Bandung city's elementary schools. Sampling was taken using purposive sampling and divided into 2 sample groups. The use of purposive sampling involves determining the sample so that researchers can easily access it. Based on purposive sampling, the samples in this study were 2 classes of 6th-grade elementary school students located in Coblong District, Bandung City. The research sample consisted of 25 grade 6 elementary school students. A total of 25 samples in the experimental group were given the Project-Based Learning treatment. A total of 25 control group samples were given the Task-Based Learning treatment. The research was carried out in one of the elementary schools located in Coblong District, Bandung City. In this research, there are two types of research variables, namely students' critical thinking abilities and measuring students' learning motivation. The method used to measure critical thinking abilities is the test method with a type of instrument in the form of test questions, while to measure students' learning motivation using a questionnaire. This instrument is used to measure students' ability to think critically in writing. The pre-test is given to see students' abilities before they receive treatment using project-based learning and task-based learning models, while the post-test is to see the results achieved by students after receiving treatment. The critical thinking ability instrument is in the form of multiple-choice questions, totaling 10 questions. This critical thinking ability test was given to 50 students. There were 25 participants in the experimental class and 25 in the control group. The validity and reliability of the assessment tool were examined by the researcher prior to the test being administered to the experimental and control classes.

The learning motivation questionnaire is used to measure students' motivation levels. This questionnaire covers aspects of students' interest, effort, and persistence in learning. The learning motivation scale was prepared based on motivation theory and has undergone validity and reliability testing in an elementary school learning environment. The analysis process was carried out to give answers to all of the questions posed by this study, specifically to the research topics:

1. Numbers 8 and 9 use analysis related to descriptive statistics, because the type of question is a descriptive question.
2. Numbers 1, 2, 3, 4, 5, 6, and 7 are types of hypothetical research questions, so to analyze them, inferential statistics are used, which are related to hypothesis testing, where each hypothesis is an answer. while from each of the hypothetical research questions above

The empirical validity of the critical thinking ability test instrument uses Pearson's product-moment correlation coefficient to obtain the correlation coefficient between the critical thinking ability acquisition scores and the students' daily scores at school. The validity criteria of the instrument are in the following table.

Table 1. Instrument validity criteria

Value r	Interpretation
0.80–1.00	Very High
0.60–0.80	High
0.40–0.60	Middle
0.20–0.40	Low
0.00-0.20	Very Low

Source: Arikunto (2017)

Validity based on daily science test score data and critical thinking ability instrument test scores was conducted on 25 6th-grade elementary school students with the following results:

Table 2. Empirical validity of critical thinking ability test instruments

		Correlations	
		Daily_test_score	Score_test
Daily_test_score	Pearson Correlation	1	0.167
	Sig. (2-tailed)		0.397
	N	25	25
Score_test	Pearson Correlation	0.167	1
	Sig. (2-tailed)	0.397	
	N	25	25

Based on the output results above, the results obtained are the empirical validity coefficient of the capacity for critical thought instrument from the daily test scores, which is 0.167. The validity score of the capacity for critical thought instrument is included in the range of $0.00 \leq r < 0.20$ with a very low category (Arikunto, 2017). So the validity the capacity for critical thought instrument is in the very low category. For the empirical validity of the student motivation questionnaire instrument, it was tested on one class of higher 7th-grade students at one of Bandung's junior high schools. After that, the validation results output was obtained, namely the statement items of the Student Motivation questionnaire instrument that were declared invalid were no. 18, 19, 20, 22, and 23. Valid items from 25 statement items, twenty statement items were deemed legitimate. The statement items used in the questionnaire consisted of 20 statement items.

The internal reliability of the capacity for critical thought test instrument for students uses Cronbach's Alpha with the following coefficient criteria (Guilford, 1956).

Table 3. Instrument reliability criteria

Reliability Coefficient	Correlation
$0.91 \leq r < 1.0$	Very High
$0.71 \leq r < 0.90$	High
$0.41 \leq r < 0.70$	Middle
$0.21 \leq r < 0.40$	Low
$R < 0.20$	Very Low

The output of the internal reliability of the capacity for critical thought test instrument for students was obtained with the following results.

Table 4. Internal reliability of the capacity for critical thought test instruments for students

Reliability Statistics	
Cronbach's Alpha	N of Items
0.525	3

Based on the output results of the table above, the reliability coefficient value is 0.525. The internal reliability value of the test instrument is included in the range of $0.41 \leq r < 0.70$ with a moderate category (Guilford, 1956). So that the internal reliability of the critical thinking ability test instrument for students is in the moderate category. The reliability of the student motivation questionnaire instrument using the Cronbach's Alpha model. The following is the output of the instrument's reliability.

Table 5. Reliability of the learning motivation questionnaire instrument

Reliability Statistics	
Cronbach's Alpha	N of Items
0.758	25

Based on the output results above, the reliability coefficient value according to the Cronbach's Alpha model is 0.758. The reliability value of the questionnaire instrument is included in the range of

$0.71 \leq r < 0.90$ with a high category (Guilford, 1956). In order for the learning motivation questionnaire's internal reliability to fall into the high category.

In a study using an instrument to measure abilities in critical thinking, it was discovered that the instrument had very low empirical validity ($r = 0.167$). Empirical validity is a metric that illustrates how much an instrument can measure what should be measured in the real world, or the extent to which the instrument is in accordance with relevant data or phenomena. This low r -value indicates that the instrument is unable to accurately reflect critical thinking skills, so that its measurement validity is questionable.

In addition, the internal reliability instrument showed moderate results ($\alpha = 0.525$). A greater α value suggests that the device is more consistent in producing comparable results when used on the same population. A greater α value suggests that even though the device has different levels of consistency, its reliability remains the same.

The decrease in the construct validity of the instrument is caused by a combination of low internal reliability and low empirical validity. The degree to which a tool can quantify a theoretical idea, in this case critical thinking skills, is called construct validity. When instruments have low empirical validity and internal reliability, they cannot provide consistent and accurate measurements of the constructs they are intended to measure, which means that the instruments used are not fully valid for measuring critical thinking abilities. Therefore, the results of these instruments may not truly reflect the facts or ideas intended in the study. Therefore, to improve the empirical validity and internal reliability of these instruments, their redevelopment or revision is very important. In order for the research results to be more reliable and reflect critical thinking skills more accurately, researchers should consider retesting the instrument or replacing the instrument with a more valid and reliable measuring instrument. This procedure will raise the caliber of the study and guarantee that the tools employed can measure the theoretical constructs in a manner consistent with the purpose of the studies.

3. FINDINGS AND DISCUSSION

3.1 *Project-Based Learning and Task-Based Learning*

A learning approach known as "project-based learning" starts with issues in order to gather and incorporate new information derived from experiences in practical tasks. Asking leading questions and assisting students in group projects that include different disciplines (resources) into the curriculum are the first steps in the inquiry process in project-based learning. Project-based learning is learning that is closely related to the real world. This will be very beneficial for students' attention and effort (Kemdikbud, 2014).

An extension of problem-based learning is project-based learning. One learning approach that emphasizes location teaching and learning, or CTL, is project-based learning (Jones, Rasmussen, & Moffit, 1997). CTL is an educational methodology that enables instructors to relate learning resources to practical contexts and motivates students to leverage their knowledge in their roles as societal members. In project-based learning, students learn through situations and settings on real or contextual problems. Therefore, each stage of learning is carried out by creating dynamics in groups, investigations, achieving a high level of student understanding, and developing individual and social skills. This project-based learning approach differs from direct learning, which prioritizes the development of educators' concepts and abilities.

Presenting issues, posing queries, and leading group discussions are the responsibilities of educators using the project-based learning approach. Project-based learning will be created if there are skills possessed by educators in developing a candid discussion and exchange of views between teachers and students. Thus, real-world situations must be used in project-based learning in order for pupils to grow and learn critical thinking skills, be skilled at solving problems, and have in-depth collaboration skills. Based on Amamou & Cheniti-Belcadhi (2018), project-based learning allows students to participate in the analysis of certain projects and find possible solutions.

Task-based learning is a teaching method that focuses on students, where students are central to all activities carried out and actively contribute to their learning (Branden, 2011). All activities are given in the form of tasks, from simple to high levels of difficulty. Task-based learning is introduced in foreign language learning for students as a method that helps students to focus on using the target language communicatively according to the conditions faced. Ilyas and Yulianto (2019) see the task-based approach in learning as helping students to be more active and independent, so that they can be more involved in their learning. In addition, Nunan (2004) also explains that structured task-based learning activities ensure that students understand, manipulate, produce, and interact in activities communicatively using the requested target language. Therefore, it may be said that in this educational process, students are not only focused on their language skills but also on their non-academic abilities, which are indirectly related to the values of the Pancasila student profile.

According to Zhou Han (2018), the Task-Based Learning (TBL) method has advantages, namely that each person in an individual or group has a different role, so that it can cause an activity or learning to be controlled, and the process of activity in the group can be controlled. The role tasks given in the Task-Based Learning (TBL) method are planning, information gathering, data organizing, schematic designing, preparing for the steps of an experiment, and presenting or delivering.

3.2 Motivation and Critical Thinking

Learning motivation is an internal or external force that propels a person to engage in learning activities with a certain objective. According to Winkel (2004), Learning motivation is the overall force that encourages students to participate in learning activities, keeps them going, and provides them with guidance so that the intended results can be achieved. Meanwhile, Sardiman (2011) stated that learning motivation serves to encourage, motivate, and direct students' learning behavior to achieve maximum results. Motivation to learn can be influenced by both internal and external variables. Interior components include interests, ideals, and desires to progress, while external factors include the learning environment, awards, family support, and other social factors.

Critical thinking requires a thorough analytical approach to the problem or situation at hand. People with critical thinking skills look for evidence to support or refute claims, evaluate arguments from multiple perspectives, and reach reasonable and rational conclusions. One of the mathematical thinking abilities that every student needs to address a variety of situations is critical thinking. Critical thinking skills are needed for students to manage their thoughts, find the right learning method, realize the importance of learning, and know the essence of learning.

With the increasingly rapid development of the information era and the increasing complexity of life, critical thinking skills are considered basic skills and need to be acquired like reading and writing (D. N. Roshitawati, 2018). In science learning, students need to cultivate critical thinking skills in order to understand science well, especially so that science is not understood only by memorization. Inquiry is one of the learning methods in science learning that can be used to improve critical thinking skills.

3.3 Result

All data is the primary data used within this research, contained in Figure 1 and Table 7, which appear as follows.

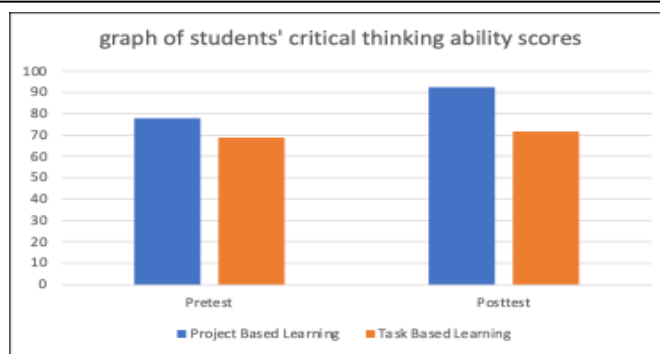


Figure 1. Graph of students' critical thinking ability scores

The aforementioned graph indicates that the average value for the pretest using project-based learning is 77.96, and for the posttest is 96.52. While the average value for the pretest using task-based learning is 68.84, and for the posttest is 71.84. The conclusion indicates a significant enhancement in the average value of learning when employing the Project-Based Learning strategy in contrast to the Task-Based Learning approach. The increase in the average value from pretest to posttest in Project-Based Learning is much greater than in Task-Based Learning, suggesting that students' learning skills are improved more effectively by the Project-Based Learning approach.

Table 6. Student Learning Motivation Questionnaire Instrument Scores

		Learning	
		PjBL	Task Based Learning
Motivation	High	100,100,100,99,99	93, 91, 90, 88
	Middle	98, 98, 97, 96, 96, 95, 95, 94, 93, 92, 91, 90,89,88,87	87, 85, 84, 83, 82, 81, 79, 78, 77, 76, 73, 72, 70, 69, 67, 66, 64
	Low	86, 85, 83, 82, 80	62, 60, 58, 55



Figure 2. Descriptive statistical output of the picture of critical thinking abilities acquisition with project-based learning and task-based learning

The average score for developing critical thinking abilities was higher for students who studied with project-based learning than for students who studied with task-based learning, based on the results of the descriptive statistics response to research question (1). The reason is that project-based learning provides learning experiences to students through contextual problems in real situations, and learning is more student-centered. This is in accordance with the opinion of Rahmaton Wahyu (2016) that project-based learning provides students with meaningful learning experiences through contextual problems in real-world situations and is student-centered. Based on the curve slope value (skewness), the distribution of critical thinking ability scores of students who study with project-based learning is the same as students who study with task-based Learning, namely, the distribution is positively skewed. This means that both groups of scores tend to converge on low scores. The reason is that students do not have much practice experience working on critical thinking skills test questions.

Table 7. Output Paired Samples t-test Project based learning

		N	Correlation	Sig.
PAIR 1	Pretest & Posttest	25	.996	.000

Results of answers to question no. 2, it was found that there was a correlation between the PjBL pretest score and the project-based learning pretest score of grade 6 students who received PjBL learning with a significance value of $\alpha = 5\%$. Sig value. (2-tailed) is <0.001 and this value is smaller than 0.05 (α), which means that project-based learning has a significant effect on the acquisition of Critical Thinking Skills for grade 6 students. The reason is that through project-based learning, students can understand contextual problems in story questions about the scarcity of energy sources, and solve contextual problems in renewable energy story problems. These results are the same as those stated by SW Prijowuntato et al. (2023), who found that project-based learning and problem-based learning provide students with learning experiences through contextual problems in real-world situations and are more student-centered.

Table 8. Output Paired Samples t-test Task-Based Learning

		N	Correlation	Sig.
PAIR 1	Pretest & Posttest	25	.998	.000

Results of answers to question no. 3, it was found that there was a correlation between the Task-Based Learning pretest score and the Task-Based Learning pretest score of grade 6 students who received Task-Based Learning, with a significance value of $\alpha = 5\%$. Sig value. (2-tailed) is <0.001 and this value is smaller than 0.05 (α), which means that Critical thinking skills are significantly impacted by task-based learning.

Table 9. Descriptive statistical output of the criteria for obtaining critical thinking skills from students who study with PjBl and TBL

		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
Result	Equal variances assumed	10.103	.003	6.730	48	.000	16.920	2.514	11.865	21.975
	Equal variances not assumed			6.730	37.622	.000	16.920	2.514	11.865	22.011

Results of answers to question no. 4, the sig value is obtained. on learning is 0.000 , and this value is significant at alpha 0.05 ($\alpha = 0.05$). So there is a difference in the influence of project-based learning and task-based learning on the acquisition of Critical Thinking Skills, with a confidence level of 95% .

Table 10. Output Test of Between-Subjects Effects (critical thinking score)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4234.845	5	846.969	28.187	.000
Intercept	187648.683	1	187648.683	6244.854	.000
Method	58.259	1	58.259	1.939	.171
Motivation	4068.907	2	2034.454	67.706	.000
Method*Motivation	2.650	2	1.325	.044	.957
Error	1322.135	44	30.049		
Total	271861.000	50			
Corrected Total	5556.980	49			

a. R. Squared = .762 (Adjusted R Squared = .735)

Results of answers to question no. 5, the sig value is obtained. At the level of learning motivation, the value is less than 0.000, and this is smaller than 0.05 (α), which means that there are differences in the level of learning motivation towards the acquisition of Critical Thinking abilities. Differences in students' levels of learning motivation play an important role in students' attitudes towards acquiring Critical Thinking abilities when solving Science AS story problems.

Table 11. Descriptive statistical output of criteria for improving critical thinking abilities of students who learn with project-based learning and task-based learning.

		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
Result	Equal variances assumed	.393	.534	9.655	48	.000	4.640	.481	3.674	5.606
	Equal variances not assumed			9.655	47.251	.000	4.640	.481	3.674	5.606

Results of answers to question no. 6, the sig value is obtained. On learning is 0.000, and this value is smaller than 0.05, meaning Project-based learning and task-based learning have different effects on students' development of critical thinking abilities.

Table 12. Output Test of Between-Subjects Effects (critical thinking gain score)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1205.395 ^a	5	241.079	62.461	.000
Intercept	3875.526	1	3875.526	1004.114	.000
Method	581.728	1	581.728	150.721	.000
Motivation	435.548	2	217.774	56.423	.000
Method*Motivation	2.925	2	1.463	.379	.687
Error	169.825	44	3.860		
Total	7057.000	50			
Corrected Total	1375.220	49			

a. R. Squared = .877 (Adjusted R Squared = .862)

Results of answers to question no. 7, the sig value is obtained. On learning (project-based learning and task-based learning models) and the level of learning motivation (interaction effect) is 0.687 and is smaller than 0.69 (α), which means that there is an interaction effect/influence between project-based learning and task-based learning and the level of learning motivation on increasing critical thinking abilities. From the R squared output, the value = 0.877 means that the project-based learning and task-based learning models with the level of learning motivation together, have an effect on increasing critical thinking abilities with a correlation coefficient of 0.877, which means that 87% of the increase in critical thinking abilities of grade 6 students is jointly influenced by learning (project-based learning and task-based learning models) and the level of student learning motivation.

Table 13. Correlation coefficient between learning motivation scores (x) and critical thinking ability acquisition (y) of a population of 6th-grade students studying with project-based learning

Unstandardized Coefficients			Standardized Coefficients			
Method		B	Std.Error	Beta	t	Sig.
1	Constant	61.528	6.559		9.381	.000
	Motivation	.433	.091	.705	4.769	.000

a. Dependent Variable: Score Critical Thinking

Results of answers to question no. 8, for sixth-grade students using project-based learning, learning motivation ratings, and the development of critical thinking abilities are positively correlated. This also means that $r^2 = (0.705)^2 = 0.50$ or 50%. Learning motivation has an impact on sixth-grade students' critical thinking skills when they use project-based learning.

Table 14. Correlation coefficient between learning motivation scores and critical thinking ability acquisition of 6th-grade students who study with task-based learning

Unstandardized Coefficients			Standardized Coefficients			
Method		B	Std.Error	Beta	t	Sig.
1	Constant	18.678	11.460		1.630	.117
	Motivation	.795	.159	.723	5.013	.000

a. Dependent Variable: Score Critical Thinking

Results of answers to question no.9. The scores for critical thinking abilities and motivation are significantly positively correlated. Every 1 unit increase in Motivation will increase the Critical Thinking Skills Score by 0.795.

Amalia's (2018) and Nuraeni's (2018) research shows that the program of PjBL in the learning cycle can improve students' learning outcomes and metacognition. This model emphasizes that students must be involved in completing projects, which helps them develop critical thinking. As shown by Etik (2022) and M. Ilyas (2019), Task-Based Learning (TBL) has demonstrated efficacy in enhancing students' linguistic abilities, especially speaking skills, with higher scores in the experimental class than in the control class. This shows that TBL facilitates increased student engagement in the learning process. As a result, their critical thinking skills can be improved with TBL. In a study conducted by Tiok Setiawan et al. (2022), a comparison between PjBL and PBL showed that both models increased students' activeness in learning activities. However, PjBL proved to be more effective in improving students' activeness and their learning outcomes. This is in accordance with previous studies showing that PjBL allows students to think critically more, especially in projects that require problem-solving.

3.4 Discussion

The findings of this study demonstrate that both Project-Based Learning (PjBL) and Task-Based Learning (TBL) contribute significantly to the improvement of elementary students' critical thinking skills, although their levels of effectiveness differ. The results indicate that students exposed to PjBL achieved substantially higher gains in critical thinking compared to those engaged in TBL. This outcome aligns with the study's primary objective and supports the assumption that student-centered, inquiry-driven approaches are more effective in fostering higher-order thinking skills. The contextual and problem-oriented nature of PjBL allows students to actively construct knowledge, thereby promoting deeper cognitive engagement and analytical reasoning.

A key interpretation of these findings lies in the experiential learning process embedded within PjBL. By engaging students in real-world problem solving, collaboration, and project development, PjBL creates opportunities for learners to practice essential components of critical thinking, such as analysis, evaluation, and inference. In contrast, while TBL also promotes active learning through structured tasks, its scope may be more limited in encouraging sustained inquiry and complex problem-solving processes. This explains why, although TBL showed statistically significant improvements, its impact was less pronounced than that of PjBL.

Another important finding is the role of learning motivation as a significant predictor of critical thinking development. Students with higher levels of motivation consistently demonstrated better critical thinking performance across both instructional methods. This supports existing theoretical perspectives that emphasize motivation as a driving force in learning, influencing students' persistence, engagement, and willingness to tackle cognitively demanding tasks. The positive correlation between motivation and critical thinking suggests that instructional strategies alone are insufficient unless accompanied by efforts to enhance students' intrinsic and extrinsic motivation.

Interestingly, the interaction effect between learning methods and motivation levels was not statistically significant, indicating that both PjBL and TBL are similarly influenced by students' motivation. This suggests that motivation operates as an independent factor that enhances learning outcomes regardless of the instructional model applied. However, the high explanatory power of the combined variables ($R^2 = 0.877$) indicates that, collectively, learning methods and motivation substantially account for the variance in students' critical thinking gains.

Despite these promising findings, the study also reveals several methodological limitations that must be considered when interpreting the results. One critical issue is the low empirical validity ($r = 0.167$) and moderate reliability ($\alpha = 0.525$) of the critical thinking assessment instrument. These limitations raise concerns regarding the accuracy and consistency of the measurements, potentially affecting the robustness of the conclusions. Therefore, future research should prioritize the development and validation of more reliable assessment tools to ensure more precise measurement of critical thinking skills.

Additionally, the relatively small sample size ($n = 50$) and the use of purposive sampling limit the generalizability of the findings. The study was also confined to a single school and a specific subject area (renewable energy), which may not fully represent broader educational contexts. External factors such as classroom environment, teacher competence, and parental support were not controlled, yet they may have influenced students' performance.

In relation to prior studies, the results corroborate existing evidence that PjBL is particularly effective in enhancing critical thinking and metacognitive skills due to its emphasis on authentic, student-driven learning experiences. Similarly, previous research on TBL highlights its effectiveness in promoting student engagement and active participation, which are foundational to cognitive development. However, this study extends the literature by explicitly comparing both approaches while incorporating learning motivation as a moderating variable.

From a practical perspective, these findings suggest that educators should prioritize the implementation of project-based approaches while simultaneously fostering students' motivation to learn. Instructional design should integrate real-world problems, collaborative activities, and

opportunities for reflection to maximize critical thinking development. At the same time, motivational strategies—such as providing meaningful feedback, setting achievable goals, and creating supportive learning environments—should be embedded within teaching practices.

Future research should expand the scope by involving larger and more diverse samples across different educational levels and contexts. It is also recommended to explore additional variables, such as self-efficacy, teacher instructional quality, and socio-cultural factors, to obtain a more comprehensive understanding of critical thinking development. Longitudinal studies may further reveal how sustained exposure to PjBL and TBL influences students' cognitive growth over time.

In conclusion, this study contributes to the growing body of evidence supporting innovative, student-centered pedagogies in enhancing critical thinking skills. While both PjBL and TBL are effective, PjBL demonstrates a stronger impact, particularly when supported by high levels of student motivation.

4. CONCLUSION

This study concludes that both Project-Based Learning (PjBL) and Task-Based Learning (TBL) significantly enhance elementary students' critical thinking skills, with PjBL demonstrating a more substantial effect, particularly when supported by higher levels of learning motivation, which was also found to positively and significantly influence students' critical thinking outcomes. These findings highlight the importance of student-centered and context-based instructional approaches, as well as the critical role of motivation in optimizing learning effectiveness. However, the study is limited by several factors, including a small sample size restricted to a single school, the use of purposive sampling, limited instructional scope, and concerns regarding the low empirical validity and moderate reliability of the critical thinking assessment instrument, which may affect the accuracy and generalizability of the results. Therefore, future research is recommended to involve larger and more diverse samples across different educational contexts, employ more valid and reliable measurement instruments, and explore additional variables such as instructional quality, socio-cultural influences, and longitudinal effects to provide a more comprehensive understanding of how instructional models and motivation interact in developing students' critical thinking skills.

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