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The Influence Of Project-Based Learning, Self-Regulated Learning, And Digital Learning On Critical Thinking Skills, Mediated By Student Learning Motivation

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Abstract

Using Partial Least Squares Structural Equation Modeling (PLS-SEM) and a descriptive quantitative approach, this study analyzes the role of learning motivation in mediating the impact of Project-Based Learning (PjBL), Self-Regulated Learning (SRL), and digital learning on critical thinking skills. An evaluation involving 192 eleventh-grade students at SMAN 1 Gowa demonstrates that the implementation of PjBL directly boosts motivation while significantly sharpening students' critical thinking. Similarly, SRL proves effective in fostering independent critical thinking, which correlates positively with increased learning drive. The use of digital learning media also contributes substantially to strengthening critical thinking capacity and active student participation during the learning process. These findings reinforce existing literature regarding the crucial role of learning motivation in shaping critical thinking mindsets. Systematically, the analysis confirms that learning motivation serves as a mediating variable linking the implementation of PjBL, SRL, and digital learning to the enhancement of students' critical thinking skills.

Keywords: Project Based Learning, Self Leguleted Learning, Digital Learning, Critical Thinking Skills, Learning Motivation.

INTRODUCTION

21 st-century education demands a transformation in the learning paradigm—shifting away from a one-way transfer of knowledge toward an emphasis on the development of students' skills and character. Increasingly complex global developments

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require educational institutions to equip students with critical thinking, creativity, communication, and collaboration skills, as well as the capacity for

independent learning. These skills serve as essential competencies, enabling students to adapt, navigate change, and resolve various real-life problems. Zubaidah (2016) explains that 21st-century learning must foster critical thinking, technological literacy, and the ability to work together and collaborate. Similarly, Kivunja (2015) states that 21st-century competencies encompass creative thinking, effective communication, collaboration, critical reasoning, and independent learning.

One competency that receives primary attention in the educational process is critical thinking. This skill is necessary for students to identify problems, analyze information, evaluate arguments, and make decisions based on logical and objective reasoning. Critical thinking not only aids students in grasping course material but also enables them to apply their knowledge to solve everyday problems. Consequently, the development of critical thinking skills must be an integral part of classroom instruction.

In addition to critical thinking, learning motivation plays a crucial role in the success of the learning process. Learning motivation acts as a driving force that encourages students to engage actively, remain persistent, and maintain enthusiasm in achieving learning objectives. Students with high learning motivation tend to demonstrate greater initiative, autonomy, and deeper involvement in learning activities. Conversely, low motivation can lead to reduced participation, a tendency toward boredom, and a lack of initiative in understanding or resolving academic challenges. Thus, learning motivation is a key factor that must be considered in efforts to enhance students' critical thinking skills.

Based on preliminary observations at SMAN 1 Gowa, several issues persist regarding students' critical thinking skills and learning motivation. Some students struggle to analyze problems, express ideas or opinions, and formulate conclusions in a systematic and logical manner. Furthermore, student participation in the learning process remains suboptimal; many students tend to be passive, lack the initiative to ask questions, become easily bored, and show little enthusiasm during lessons. This situation indicates that students' critical thinking skills and learning motivation require improvement through the implementation of more effective learning processes that align with the demands of 21st-century education.

Given these conditions, it is essential to examine various factors that can support the enhancement of students' critical thinking skills. Project-Based Learning is expected to foster active student engagement through project-oriented activities; Self-Regulated Learning can assist students in developing the ability to manage and evaluate their own learning processes; and Digital Learning can broaden access to information sources and diverse learning experiences. These three factors also have the potential to bolster

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students' learning motivation, which, in turn, can contribute to the development of their critical thinking skills.

Objectives

This article intends

1. Analyzing the influence of Project-Based Learning on students' critical thinking skills.
2. Analyzing the influence of Self-Regulated Learning on students' critical thinking skills.
3. Analyzing the influence of Digital Learning on students' critical thinking skills.
4. Analyzing the influence of Project-Based Learning, Self-Regulated Learning, and Digital Learning on students' learning motivation.
5. Analyzing the influence of learning motivation on students' critical thinking skills.
6. Analyzing the role of learning motivation in mediating the influence of Project-Based Learning, Self-Regulated Learning, and Digital Learning on students' critical thinking skills.

DISCUSSION

1. Respondent Characteristics

The demographic profile of the 192 eleventh-grade students from SMAN 1 Gowa who participated in this study is summarized in Table 1. Regarding gender composition, female respondents make up the majority of the sample, totaling 102 individuals (53.1%), while male respondents account for 90 individuals (46.9%). In terms of age distribution, the largest group consists of 16-year-old students, numbering 123 (64.1%). The next largest group comprises 17-year-olds, with 63 students (32.8%). Additionally, there are 4 respondents (2.1%) aged 15, while the remaining 2 respondents (approximately 1%) are 18 years old.

Table1. Respondentn Characteristics

Description	Type	Amount	Percentage (%)	Information
Gender	Man	90	46,9	The number of respondents is dominated by women.
	Woman	102	53,1	
Age	15 years old	4	2,1	The number of respondents is dominated by those aged 16..
	16 years old	123	64,1	

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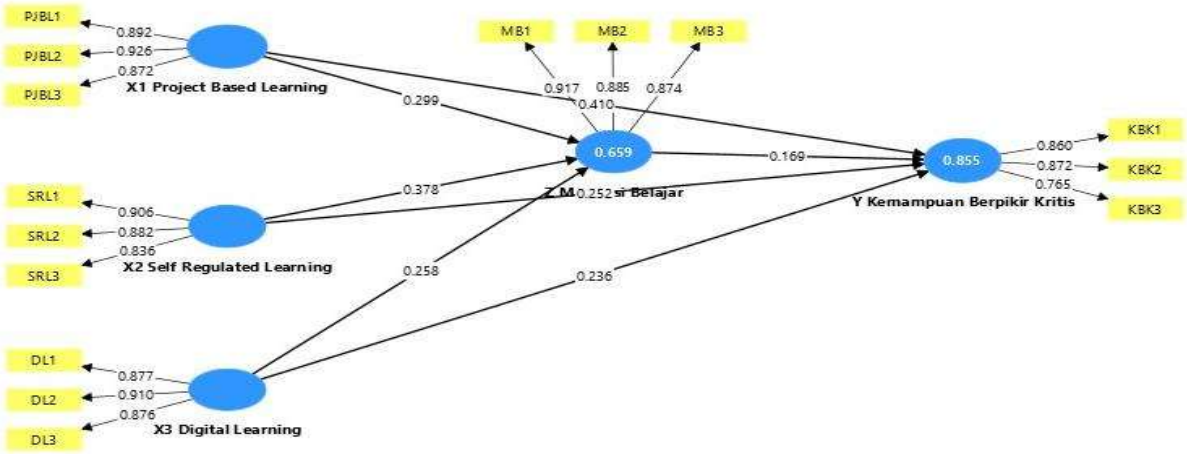
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	17 years old	63	32,8	
	18 years old	2	1	
Class	XI	192	100	-

Source: Data Analysis Results, 2026

2. Data Instrument Testing

a. Measurement Model



Picture 1. Measurement Model

Table 2. Validitas Konvergen and Reability

Variable	Item	Validitas Konvergen		Reabilty	
		Loading Factor	AVE	*Chronbach's Alpha*	*Rho_A*
PjBL	PjBL1	0.892	0.805	0.879	0.886
	PjBL2	0.926			
	PjBL3	0.872			
SRL	SRL1	0.906	0.765	0.847	0.857
	SRL2	0.882			
	SRL3	0.836			
DL	DL1	0.877	0.788	0.866	0.872
	DL2	0.910			
	DL3	0.876			

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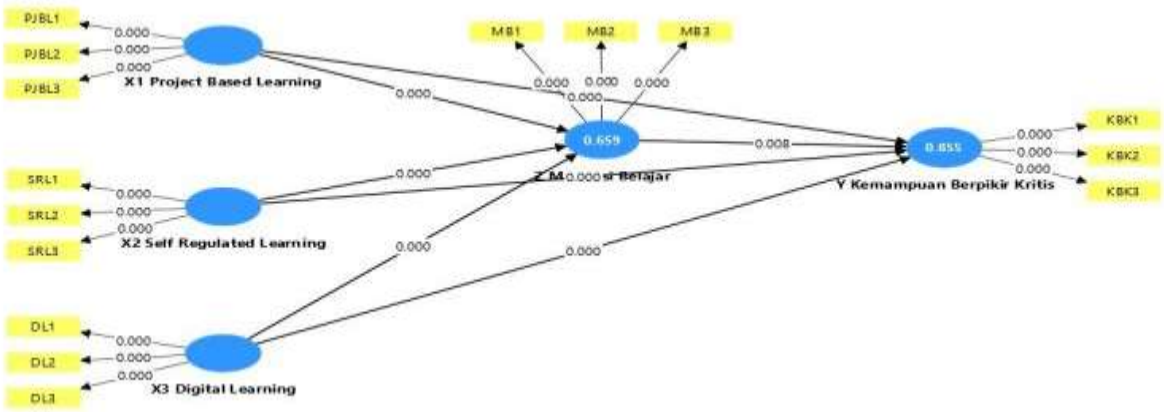
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CTS	CTS1	0.860	0.695	0.779	0.789
	CTS2	0.872			
	CTS3	0.765			
LM	LM1	0.917	0.796	0.872	0.875
	LM2	0.885			
	LM3	0.874			

Source:Resultsof data processing using SmartPLS 4, 2026

Testing the validity and reliability of research instruments is a crucial initial step to ensure the suitability of the measurement tools. As shown in the data presented in Table 2 and Figure 2, convergent validity is established, with all indicators exceeding the minimum thresholds—factor loadings are above 0.70, and the Average Variance Extracted (AVE) values are greater than 0.50. Reliability testing further reinforces these findings, as the Rho_A and Cronbach's Alpha coefficients for each variable consistently score above 0.70. These results confirm that all constructs are both reliable and valid for use in the subsequent data analysis phase.

Hypothesis Testing



Picture 2. Hypothesis Testing

Table 2. Hypothesis Testing

Hypothesis Test Results	Hypothesis	Std.	T Statistics	P Value	Keterangan
Direct Effect	$X_1 \rightarrow Y$	0.072	5.727	0.000	Supported
	$X_1 \rightarrow Z$	0.069	4.351	0.000	Supported
	$X_2 \rightarrow Y$	0.044	5.740	0.000	Supported

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	$X_2 \rightarrow Z$	0.081	4.691	0.000	Supported
	$X_3 \rightarrow Y$	0.053	4.470	0.000	Supported
	$X_3 \rightarrow Z$	0.065	3.943	0.000	Supported
	$Z \rightarrow Y$	0.064	2.661	0.000	Supported
Indirect Effect	$X_1 \rightarrow Z \rightarrow Y$	0.021	2.400	0.016	Supported
	$X_2 \rightarrow Z \rightarrow Y$	0.028	2.291	0.022	Supported
	$X_3 \rightarrow Z \rightarrow Y$	0.022	1.965	0.049	Supported

Source:Resultsof data processing using SmartPLS 4, 2026

The bootstrapping analysis results in Table 6 confirm the significance of all hypothesis tests (H_1 through H_10), which evaluate the influence of Project-Based Learning (X_1), Self-Regulated Learning (X_2), and Digital Learning (X_3) on Critical Thinking Skills (Y)—both directly and through the mediating role of Learning Motivation (Z). All paths meet the significance threshold, indicated by t-statistic values > 1.96 and p-values < 0.05. These three instructional strategies are shown to provide a strong impetus for enhancing both students' learning motivation and their critical thinking skills. Furthermore, the role of Learning Motivation (Z) as a direct predictor of Critical Thinking Skills (Y) underscores its function as a reinforcing element within the structural model. These findings imply that the development of students' critical reasoning can be accelerated by integrating project-based learning, self-regulated learning, and digital media—whether through direct effects or via motivational mediation. This mediating role is specifically confirmed by the results for
otheses H_7, H_8, and H_9, all of which yielded p-values < 0.05. The substantiation of these indirect effects supports the acceptance of all proposed mediation hypotheses. In practical terms, the effectiveness of digital learning, self-regulated learning, and project-based learning in sharpening students' critical thinking is optimized when supported by high, stable, and consistent learning motivation. These results further clarify that learning motivation serves a crucial function as a reinforcing link between the key variables examined in this study.

1. The Influence of Project-Based Learning on Critical Thinking Skills

The research results indicate that Project-Based Learning has a positive and significant influence on the critical thinking skills of students at SMAN 1 Gowa. This suggests that project-based learning encourages students to be more active in analyzing problems, expressing opinions, collaborating, and finding solutions. Through direct involvement in learning activities, students gain experiences that help develop their critical thinking skills. These findings are consistent with the work of Lestari et al. (2021),

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who explain that the implementation of Project-Based Learning can enhance the quality of instruction by fostering active student engagement.

2. The Influence of Self-Regulated Learning on Critical Thinking Skills

The research results demonstrate that Self-Regulated Learning has a positive and significant influence on students' critical thinking skills. This indicates that students who are capable of independently planning, executing, and evaluating their own learning processes tend to be more proficient in understanding, analyzing, and resolving problems. Learning autonomy also encourages students to take responsibility for their own learning, thereby helping them develop a logical and systematic mindset. These findings align with the study by Roslinda et al. (2022), which highlights a connection between autonomous learning and critical thinking skills.

3. The Influence of Digital Learning on Critical Thinking Skills

The research results indicate that Digital Learning has a positive and significant influence on students' critical thinking skills. The utilization of digital technology makes it easier for students to access various information sources, comprehend course material, and explore knowledge more broadly. Through the use of digital media, students are able to compare information, evaluate sources, and develop analytical skills. These findings are consistent with Maskur and Safitri (2021), who explain that the use of Android-based teaching materials can support the learning process.

4. The Influence of Project-Based Learning, Self-Regulated Learning, and Digital Learning on Learning Motivation

The research results indicate that Project-Based Learning, Self-Regulated Learning, and Digital Learning have a positive and significant influence on students' learning motivation. Project-Based Learning encourages active engagement through project-based activities; Self-Regulated Learning fosters greater responsibility and autonomy in learning; and Digital Learning provides a more engaging and flexible learning experience. Together, these three aspects can enhance students' enthusiasm and drive to participate in the learning process. These findings align with the work of Setiawan et al. (2020), Prastiwi et al. (2020), and Azzahra and Prasetyo (2024), all of whom discuss the importance of learning strategies, learner autonomy, and the use of technology in supporting learning motivation.

Negotiation leads to solving disputes and arguments in the business setup which may, in turn, worsen the working atmosphere, if it is unsolved. Negotiators are expected to explore numerous alternatives in solving a problem. To ease the task of finding numerous alternatives, negotiators have to excel in better communication. Negotiation skill is the key for getting on in the workplace setup and it further aids in resolving conflicts. In the lieu of maintaining relationships, it is highly essential to resolve conflict.

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5. The Influence of Learning Motivation on Critical Thinking Skills

The research findings indicate that learning motivation has a positive and significant influence on students' critical thinking skills. This suggests that students with high motivation tend to be more active, diligent, and enthusiastic in their engagement with the learning process. Such drive encourages students to take the initiative in seeking information, asking questions, analyzing problems, and drawing logical conclusions. Consequently, learning motivation serves as a crucial factor in supporting the development of students' critical thinking skills.

6. The Role of Learning Motivation in Mediating the Influence of Project-Based Learning, Self-Regulated Learning, and Digital Learning on Critical Thinking Skills

The research findings demonstrate that learning motivation plays a role in mediating the influence of Project-Based Learning, Self-Regulated Learning, and Digital Learning on students' critical thinking skills. This indicates that the implementation of project-based learning, self-regulated learning, and the use of digital technology can foster student motivation, leading to greater activity and engagement in the learning process. This motivation, in turn, supports students in comprehending course material, analyzing information, and resolving problems logically. Thus, learning motivation acts as a connecting factor between learning experiences and the development of students' critical thinking skills.

CONCLUSION

The empirical exploration in this study confirms the crucial roles of Project-Based Learning, Self-Regulated Learning, and Digital Learning in stimulating students' critical thinking skills and learning motivation, although the magnitude of their contributions varies across the different testing pathways. The combination of Project-Based Learning and Self-Regulated Learning emerges as the most dominant approach for sharpening students' critical thinking. Simultaneously, Self-Regulated Learning proves to be the most powerful driver for enhancing overall learning motivation. These findings imply that the integration of project-based learning, the optimization of learner autonomy, and the purposeful use of digital media serve as essential strategic pillars for transforming the effectiveness and quality of the educational process.

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