

E-Learning, Self-Efficacy, and Motivation: Their Influence on Critical Thinking in IPAS Learning

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ABSTRACT

21st-century education requires students not only to master knowledge but also to possess critical, creative, communicative, and collaborative thinking skills (4C skills) to address global challenges. This quantitative correlational study examines the impact of e-learning, self-efficacy, and learning motivation on critical thinking skills in elementary science. The research was conducted with all 63 fourth-grade students at SDN Wonoasih 2 Probolinggo. The research instrument was deemed valid and reliable, and the data were analyzed using classical assumption tests, including the Kolmogorov-Smirnov test for normality, linearity, multicollinearity, and heteroscedasticity. This was followed by t-tests, F-tests, and determination coefficients (R^2). The analysis revealed a significant collective impact of e-learning, self-efficacy, and learning motivation on critical thinking. Motivation emerged as the most dominant contributing factor, with self-efficacy and e-learning exhibiting subsequently lesser, yet still significant, influence. Simultaneously, the three variables explained 46.5% of the variation in critical thinking ability, while the remaining factors influenced the remaining variation. These findings underscore the importance of integrating problem-solving-based e-learning, enhancing self-efficacy through constructive feedback, and promoting motivation for relevance-based learning and autonomy. The following study suggested adding other variables, such as learning style, family support, and infrastructure readiness, by using a qualitative or mixed-methods approach, and expanding the sample across different levels and regions to improve generalizability.

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1. INTRODUCTION

Education in the 21st century emphasizes not only the mastery of knowledge but also high-level thinking skills, including critical, creative, communicative, and collaborative thinking. These four competencies are often referred to as the 4C skills, which form the foundation for students to adapt to social, technological, and global changes [1], [2], [3].

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Based on these four competencies, critical thinking is a crucial aspect because it serves as the foundation for decision-making, problem-solving, and the logical and systematic processing and assessment of information [4], [5]. Critical thinking skills are defined as the ability to distinguish pertinent information, conduct logical evaluations of arguments, and derive conclusions that are supported by evidence [6].

Critical thinking serves as the foundation for making reasoned judgments about what to accept as true and how to proceed [7], [8]. This is crucial to be developed from the basic education level, especially in the subject of IPAS (Natural and Social Sciences), which requires students to observe, analyze, draw conclusions, and understand natural and social phenomena [9], [10]. However, in reality, many elementary school students still have difficulty in developing critical thinking skills, especially because learning methods are still conventional, less interactive, and do not challenge students to think deeply [11], [12].

The integration of e-learning is widely regarded as a viable solution to this challenge. E-learning not only provides an alternative in delivering material, but also offers ease of access, flexibility of time and place, as well as a more interesting and interactive presentation of material [13]. E-learning delivers a suite of learning solutions that can improve knowledge and skills [14], [15]. In the context of IPAS learning, e-learning can be used to present simulations, experimental videos, and interactive quizzes that help students build conceptual understanding and critical thinking visually and contextually.

The interplay of e-learning, self-efficacy, and learning motivation plays a significant role in cultivating students' critical thinking abilities [16], [17], [18], [19]. This means that when these three things are implemented properly, students' critical thinking skills also tend to increase. E-learning, self-efficacy, and motivation are thought to jointly develop critical thinking skills by promoting a stimulating learning environment that encourages deeper and more systematic analysis.

However, there are still gaps in its implementation in various elementary schools, including SDN Wonoasih 2 in Probolinggo City. Based on initial observations, IPAS learning remains dominated by lecture and memorization methods, while the implementation of e-learning is suboptimal. Not all students have high self-efficacy in independent learning, and some students also show low motivation to learn. Such conditions risk undermining the cultivation of critical thinking skills, a fundamental goal of the IPAS curriculum.

Previous research reveals that the continued dominance of lecture-based methods in elementary social studies instruction inadequately supports the development of critical thinking skills [20], [21], [22], [23]. Research by Timotheou et al. [24] and Masnawati & Kurniawan [25] found that limited infrastructure, teachers' digital skills, and student access are factors inhibiting the optimization of online learning. Further research has demonstrated that self-efficacy significantly influences students' capacity for independent learning, with those exhibiting low self-efficacy often struggling to learn autonomously [26], [27], [28], [29]. Conversely, research establishes motivation as a pivotal factor in cultivating critical thinking abilities [30], [31], [32], [33], [34].

Hence, there is a clear rationale for empirically investigating the effects of e-learning, self-efficacy, and learning motivation on critical thinking skills within the context of fourth-grade science education. The findings are expected to elucidate the individual contributions

of these factors to the development of critical thinking, thereby providing an evidence-based foundation for designing innovative, adaptive, and competency-oriented learning strategies. Therefore, the primary aim of this research is to analyze the impact of e-learning, self-efficacy, and learning motivation on critical thinking skills in science among fourth graders at SDN Wonoasih 2 Probolinggo.

2. METHOD

This study employs a quantitative correlational approach to investigate the effects of E-Learning, Self-Efficacy, and Learning Motivation on Critical Thinking Skills among students at SDN Wonoasih 2 Probolinggo. The school was selected as the research site based on its status as a large public institution and its role as a reference school for implementing the Independent Curriculum, particularly in Grade IV. However, despite this standing, the implementation of e-learning and the development of critical thinking in social studies remain suboptimal, making this a pertinent and compelling area for research.

The population of SDN Wonoasih 2 Probolinggo, particularly in grade IV, consists of 63 students. For populations under 100, a total population sampling technique is often employed [35]. Then, this research employs total sampling, designating all 63 students in grade IV as the research sample.

A Likert-scale questionnaire (1-5) served as the data collection tool. The researcher compiled the questionnaire by referring to indicators that had been developed in previous research, so that each statement item had a clear conceptual basis. Critical thinking ability as a bound variable is measured with instruments developed based on indicators of [36], which includes 1) elementary clarification; 2) basic support; 3) inference; 4) advanced clarification; 5) strategy and tactics, with a total of 12 statements. The e-learning usage variable is designed to refer to indicators from [37] which include aspects 1) affective; 2) cognitive; 3) psychomotor; 4) attractiveness, relevance; 5) ease of understanding; 5) and interactivity, with a total of 14 statements. Furthermore, the self-efficacy variables are compiled based on the indicators put forward by [38], namely 1) individual confidence in overcoming task difficulties; 2) facing obstacles; 3) diligence in completing tasks; and 4) the ability to utilize life experiences to achieve success, with a total of 10 statement items. The motivation to learn is measured based on indicators from [39], which includes 1) the desire and desire to succeed; 2) learning motivation and needs; 3) future goals; 4) appreciation in learning; 5) interesting learning activities; and 6) a conducive learning environment with a total of 12 statements.

Before being used as a research instrument, each statement item in the questionnaire must undergo a validity test process to ensure that the items accurately measure the indicators and variables in question. Validity testing was conducted on the instruments for all four variables. The results indicated that all items were valid. Subsequently, reliability analysis demonstrated that all variables obtained a Cronbach's alpha value exceeding 0.6, thus establishing the instrument's reliability.

The data were processed and analyzed in SPSS, following a standard procedure that started with testing the classical assumptions. The test included normality using Kolmogorov-Smirnov, linearity, multicollinearity with VIF criteria of < 10 and Tolerance

> 0.1, and heteroscedasticity. Following the validation of all regression assumptions, a multiple linear regression analysis was conducted to assess the influence of the independent variables on the dependent variable, both individually and collectively. Hypothesis testing was performed using t-tests to determine the partial effect of each predictor and an F-test to evaluate the overall model's significance. Additionally, the coefficient of determination (R^2) was calculated to measure the proportion of variance in the dependent variable explained by the independent variables.

3. RESULTS AND DISCUSSION

3.1. Results

Following data collection via a closed-ended Likert-scale questionnaire, statistical analyses were conducted to examine the relationships and influences of the variables. The data analysis commenced with prerequisite tests, including normality (Kolmogorov-Smirnov), linearity, and multicollinearity, before proceeding to correlation and multiple linear regression analyses. The Kolmogorov-Smirnov test yielded a significance value of 0.200, indicating a normal distribution, as the value exceeds the 0.05 threshold.

The analysis proceeded with a linearity test. The significance values for the relationship of each independent variable with critical thinking skills (Y) were all above 0.05 ($X_1=0.472$, $X_2=0.495$, $X_3=0.511$). This confirms that the data for all three independent variables meet the linearity assumption, making them suitable for inclusion in a multiple linear regression model.

Subsequently, a heteroscedasticity test indicated the absence of heteroscedasticity, as all significance values exceeded the required threshold. The subsequent multicollinearity assessment revealed that all independent variables exhibited tolerance values exceeding 0.10 and VIFs under the 10.00 threshold, thereby confirming that multicollinearity was not a concern in the model. The final phase of the analysis involved conducting a multiple linear regression. The multiple linear regression results indicate that the constant (0.857) was not statistically significant ($\text{Sig.} = 0.078 > 0.05$). In contrast, the regression coefficient showed that E-learning ($X_1 = 0.135$), Self-Efficacy ($X_2 = 0.292$), and Learning Motivation ($X_3 = 0.365$) exerted a positive influence on critical thinking skills, with Learning Motivation demonstrating the greatest impact, followed by Self-Efficacy and E-learning.

The results of the T test, which assessed the individual influence of each predictor, are shown in Table 1.

Table 1. T-test results

Variable	Regression Coefficients (B)	Std. Error	t count	Sig.	t table	Decision
(Constan)	0.857	0.478	1.791	0.078	—	—
E-learning (X1)	0.135	0.062	2.163	0.035	2.001	Significant
Self-Efficacy (X2)	0.292	0.066	4.415	0.000	2.001	Significant
Learning Motivation (X3)	0.365	0.066	5.540	0.000	2.001	Significant

Based on table 1, the three independent variables, namely E-learning ($t = 2.163$; $\text{Sig.} = 0.035$), Self-Efficacy ($t = 4.415$; $\text{Sig.} = 0.000$), and Learning Motivation ($t = 5.540$; $\text{Sig.} =$

0.000), were proven to have a significant effect on critical thinking skills (Y), with the greatest influence given by Learning Motivation, followed by Self-Efficacy, and E-learning. An F-test was subsequently conducted to assess the joint significance of the independent variables, with the results presented in Table 2.

Table 2. F test results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.457	3.000	0.819	17.066	0.000
	Residual	2.831	59.000	0.048		
	Total	5.289	62.000			

The statistical model was found to be significant, as shown in Table 2. The test statistic (F = 17.07) was significantly larger than the benchmark value of 2.76 (F table), indicating that the independent variables, as a group, have a real effect on the dependent variable. Following this significant result, the model's explanatory power was further investigated with an R-squared test, reported in Table 3.

Table 3. Result coefficient of determination (R2)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.682	0.465	0.437	0.21907

According to Table 3, the model explains 46.5% of the differences in students' critical thinking skills. The three factors e-learning, self-efficacy, and learning motivation are responsible for this explanation, while other unmeasured factors account for the remaining 53.5%.

3.2. Discussion

The analysis reveals that e-learning utilization, self-efficacy, and learning motivation are all significant individual predictors of students' critical thinking skills. The positive effect of e-learning is attributed to its provision of diverse learning resources and a flexible academic environment [40], [41]. This encourages students to compare, filter, and evaluate information from various perspectives, thereby practicing analytical skills and synthesizing the core processes of critical thinking. This finding aligns with prior research demonstrating the efficacy of online problem-based models in fostering critical thinking, as well as studies documenting similar gains among e-learning users across diverse subjects [42], [43], [44], [45]. In addition, interactive features on e-learning platforms (e.g., problem-solving assignments, collaborative discussions, and instant feedback) reinforce the reflective and metacognitive thinking practices necessary for argument evaluation and rational decision-making [46], [47], [48].

Self-efficacy has been shown to strengthen critical thinking skills because students' confidence in their capacity encourages perseverance when facing complex problems, courage to take initiative, and independence in formulating and evaluating solutions [49], [50], [51]. These characters support the critical thinking process. These findings are consistent with research by Orakci [52], Lin [53], and Yıldız-Feyzioğlu & Kıran [54], who reported a positive correlation between self-efficacy and critical thinking, noting that this

relationship was more pronounced in students with high self-efficacy. Mechanically, self-efficacy increases cognitive resilience and the tendency to undertake more complex and systematic problem-solving strategies [55].

Learning motivation is a major driving factor that strengthens students' cognitive and affective engagement. Motivated students tend to seek information, question assumptions actively, and delve into the material, thereby developing their analytical and evaluative skills [56], [57], [58]. This study's findings regarding the powerful effect of motivation are consistent with existing literature, which confirms that motivation is a key factor in developing critical thinking skills at multiple educational stages [59], [60]. However, the effectiveness of motivation in facilitating critical thinking also depends on the availability of proper learning strategies; without adequate strategies, high motivation does not automatically lead to increased critical thinking [61], [62], [63], [64].

Simultaneously, these three variables complement each other in shaping critical thinking skills: e-learning provides a rich learning resource and environment, self-efficacy ensures that students have the courage and resilience to make effective use of the environment, and motivation energizes them to continue engaging and delving deeper into the material. Although the shared model of all three variables explains a substantial proportion of variance, there is still a large proportion of variance explained by other factors such as students' early abilities, family support, infrastructure readiness, individual learning styles, and other psychological factors [65], [66]. Based on educational practices, these results recommend the integration of e-learning platforms designed for problem-solving activities and meaningful interactions, thereby strengthening efficacy through successful experiences and constructive feedback, as well as efforts to increase motivation through content relevance and fostering learning autonomy.

4. CONCLUSION

In summary, e-learning, self-efficacy, and learning motivation all significantly impact critical thinking skills, with motivation being the strongest predictor, followed by self-efficacy and then e-learning. Simultaneously, the three explained 46.5% of the variance in critical thinking skills. At the same time, the rest were influenced by other factors, emphasizing the importance of integrating problem-solving-based e-learning platforms, strengthening self-efficacy through constructive feedback, and increasing motivation through relevance and learning autonomy to produce more holistic and effective learning strategies in the digital era.

The following study is suggested to add other relevant variables such as learning style, family support, or infrastructure readiness to expand the scope of factors that affect students' critical thinking skills, use qualitative methods or mixed methods to permits a thorough investigation into the process of internalizing motivation, self-efficacy, and dynamics of e-learning use that have not been revealed through a quantitative approach, as well as expanding the sample at different levels of education or other areas so that the research results have a wider generalization power.

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