



Educational Transformation: Implementation of Technology-Based Learning Models in Improving Critical Thinking Skills in Boarding School Environments

Nadira Putri Valencia¹, Saddam Fajar Shodiq¹

¹Faculty Islamic Educations, Universitas Muhammadiyah Yogyakarta, Indonesia

*Correspondence to: nadira.putri.fai21@mail.umy.ac.id

Abstract: Implementing technology-based learning models is crucial for fostering students' critical thinking skills inside a school dormitory setting. This research aims to assess the impact of technology-based learning models on the development of students' critical thinking skills at boarding schools located in Yogyakarta. This research included a sample of 298 students from boarding schools in Yogyakarta. This research employed quantitative methodologies, namely utilizing a Likert scale survey. Four boarding schools were included in this research. Researchers used the SmartPLS version 4 technology to conduct experiments and validate this notion. The research results demonstrate that the utilization of technology in learning has a beneficial impact on students' aptitude for critical thinking. Implementing technology-based learning methods in boarding schools is essential to maintain a harmonious integration of technological advancements. However, it is sufficient for students to enhance their critical thinking skills.

Keywords: technology-based learning models, critical thinking skills, boarding school

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INTRODUCTION

Acquiring critical thinking skills is crucial for students to confront the challenges of the 21st century (Jamaludin et al., 2022). Critical thinking is the cognitive process by which students analyze and evaluate information meticulously and profoundly. When confronted with an issue, the application of critical thinking skills enables students to carefully and judiciously consider potential solutions (Zubaidah & Corebima, 2021). Moreover, students with proficient critical thinking skills can engage actively and effortlessly in many disciplines (Fikriyatii et al., 2022). Students with advanced critical thinking skills find it effortless to analyze and resolve real-life issues (Temel, 2022). Students possessing robust critical thinking skills will demonstrate the capacity to efficiently and accurately accomplish a wide range of academic tasks. Students possessing proficient critical thinking skills are more adept at scrutinizing and deliberating upon phenomena or topics. Facione (2011) asserts that critical thinking can enhance intellect, facilitate task completion, and uncover alternate solutions to issues. Possessing critical thinking skills enables an individual to discern between ideas and facts and assess the various forms of information in order to arrive at conclusions. Academics and studies (Kane & Otto, 2018) have emphasized the significance of critical thinking skills in the 21st-century educational setting. It is crucial to teach children how to think critically and effectively due to the vast accessibility of knowledge with a single click in today's era. Critical thinking is typically aligned with other essential skills for 21st-century student learning, including metacognition, motivation, and creativity (Bezanilla et al., 2019). Teaching students critical thinking is crucial for their cognitive growth since it allows them to effectively acquire, analyze, and utilize knowledge and information (Gul et al., 2014).

According to Facione (2011), critical thinking is essential in educational and professional contexts, and it has implications for participation in global society. Students with proficiency in critical thinking would be able to acclimatize to professional environments, broaden their perspectives, and engage with the global society as inquisitive and innovative individuals. It is crucial to offer constructive feedback and engage students in activities that promote analytical and evaluative thinking in order to facilitate the development of critical thinking skills in students who struggle with it. Nurturing these abilities can assist children in becoming more proficient and self-reliant learners. Developing critical thinking skills is crucial for students due to its significance. Nevertheless, the level of critical thinking in learning activities remains generally low in schools (Arsyad et al., 2023). The lack of student motivation and interest results in decreased engagement and participation in the learning process. During the learning process, students are not obligated to employ critical thinking skills when resolving problems (Ichsan et al., 2023). The results of the 2018 TIMSS (Trends in International Mathematics and Science Study) research show that the critical thinking skills of students in Indonesia still need to be improved. The score

obtained by Indonesian students in this aspect only reached 396, which is significantly lower than the international standard, which is 500 (Putra et al., 2023). In line with the research conducted by Listiqowati and Ruja (2022), the utilization of inadequate learning models and practices negatively affects students' capacity for critical thinking.

Transformative learning, as advocated by Friman et al. (2018), can address this issue by promoting students' critical analysis and questioning of their preconceived notions and ideas. Transformative methodologies enhance the cultivation of critical thinking skills. Students are taught to avoid accepting information without further investigation and instead to analyze and scrutinize assumptions, as well as to discern the underlying reasoning behind arguments. As students transition from conformative or reformatory learning to transformative learning, they will encounter resistance from institutions, politics, and themselves. This shift towards higher-order learning will challenge their existing ideas and beliefs, necessitating a complete reconstruction of meaning (Sterling, 2013). The foundational principles of transformative learning were established by Fisher (1989) and Lewin (1951). The fundamental concept underlying transformative learning is the process of engaging in critical reflection. The core of transformational learning is participatory education, which fosters critical reflection and results in alterations in cognitive patterns (Mezirow, 1997). Transformational learning, achieved via the integration of participatory pedagogy and critical reflection, offers a robust framework for profound shifts in students' perspectives on the world, self-perception, and engagement with new knowledge.

"Transformations in learning" is the term used to describe the ongoing advancements and adaptations in the field of education to meet the evolving needs and preferences of students. In light of the digital age, this transformation holds significant importance. An essential element of the educational transformation involves integrating digital technology into the teaching and learning process. Optimizing the teaching and learning experience entails the utilization of computers, tablets, interactive whiteboards, internet resources, and instructional software. The recognition that students require more than mere information to thrive in a dynamic and interconnected world is the driving force for continuous educational reform. The objective of this research is to gather empirical data on the influence of technology-based learning models in boarding schools on students' critical thinking skills, taking into account the context of the problem described earlier. Furthermore, the data will be analyzed by researchers to enhance comprehension of the impact of technology on the enhancement of critical thinking skills. The purpose of this scientific paper is to examine, analyze, and record the effects of incorporating technology-based learning models in boarding school settings on enhancing students' critical thinking skills.

METHODS

The research adopted a descriptive-quantitative approach with content analysis techniques. The quantitative aspect, referred to by Tashakkori and Creswell (2007), facilitates the collection and analysis of numerical data to evaluate the effectiveness of technology-based learning towards the development of critical thinking skills. The descriptive component, referring to Simanjuntak and Fitriana (2020), presents a comprehensive overview of the context of boarding schools and the implementation of technological learning models. This method allowed for objectively measuring the improvement of critical thinking skills while exploring the dynamics of educational transformation in the dormitory environment. The integration of these approaches allowed researchers not only to quantify skill improvement quantitatively but also to understand in depth the key factors and challenges in the implementation of technology-based learning in boarding schools. The result is a comprehensive analysis of the effectiveness of technology integration in improving students' critical thinking skills in boarding educational environments.

This research focused on students from four schools that have boarding schools in Yogyakarta. Students from these schools were asked to fill out questionnaires to improve their critical thinking skills. The researchers employed a random sampling methodology. The research encompassed a total of 289 participants, out of which 259 students completed the questionnaire and satisfied the necessary criteria. However, 39 participants did not match the specified requirements. When expressed as a percentage, 86.91% of the participants met the specified requirements, while 13.09% did not match the criteria. Table 1 displays the quantity of samples obtained from each school.

Table 1. Population and Sample Data

School	Number of Samples
MBS-Muhiba Yogyakarta	63
Mu'allimin Yogyakarta	37
SMA 7 Muhammadiyah Yogyakarta	74
Man 2 Yogyakarta.	85
Total Samples	259

This research employed a questionnaire as a means of data collecting, wherein respondents provided direct responses either through a paper-based questionnaire or by utilizing Google Forms. The questionnaire was a pre-designed closed questionnaire. The questionnaire inquiry was evaluated using a Likert scale. This scale was extensively utilized and required respondents to indicate their level of agreement or disagreement with each statement on a stimulus object.

Table 2. Likert Scale

Alternative Answers	Scoring	
	Positive	Negative
Strongly Disagree	5	1
Disagree	4	2
Doubtful	3	3
Agree	2	4
Strongly Agree	1	5

To measure the variables of technology-based learning models, a framework developed by [Seels and Glasgow](#) (1998) was used. The scale includes indicators that evaluate problem-solving abilities, systematic analysis skills, and the use of technology in the learning process. The factor analysis carried out on the variables of the technology-based learning model showed that all indicator items had values above or equal to 0.5, which confirmed their validity. Composite reliability evaluation methods were used to test the reliability of the instrument, both for indicators and constructs. The calculation results for each variable item of the technology-based learning model showed a composite reliability exceeding 0.7. This score indicates a high level of technology-based learning model variables. The measurement of critical thinking variables was carried out using a framework developed by [Dilekli](#) (2017). This scale consisted of several aspects, namely interpretation, analysis, evaluation, inference, self-regulation, and explanation. The results of factor analysis for each variable in the technology-based learning model showed that all indicator items have a minimum value of 0.5, which confirms their validity. A composite reliability evaluation method was applied to test the reliability of the instrument, both at the indicator and construct levels. Calculations performed on each item of critical thinking variables resulted in composite reliability values above 0.7. This score indicates a significant quantity associated with critical thinking variables.

In the data collection process, a small percentage of respondents filled out the questionnaire through Google Forms, while the majority of students completed the questionnaire in a written format, indicating that among the students who participated in the research, the method of filling out the questionnaire in writing was more chosen compared to the digital method. This research employed the Smart-PLS data analysis technique. The SmartPLS software utilized Partial Least Squares (PLS) based on variance to draw conclusions. Subsequently, data is gathered and processed using this program ([Hair & Sarstedt, 2021](#)). Subsequently, the data underwent processing utilizing the SEM-PLS methodology and the SmartPLS software, encompassing both an outer model test and an inner model test. Due to the limited amount of prior research on the use of technology-based learning models to enhance critical thinking skills in boarding school settings, the data analysis approach utilized for this research was SEM-PLS. Once data is collected and analyzed, hypotheses are subjected to testing ([Hair et al., 2018](#)). [Figure 1](#) depicts the theoretical framework employed in this research. The research hypothesis posits that the technology-based learning paradigm (X) exerts an impact on critical thinking (Y).



Figure 1. Research Conceptual Model

Measurements used in studies must possess a significant degree of validity and reliability. Construct-related validity pertains to the extent to which a measurement instrument aligns with the relevant theory, as supported by data ([Ruel et al., 2015](#)). The purpose of the structural model test was to examine the hypothesis and assess the relationship between variables. This test is conducted following validity and reliability tests, ensuring that the obtained results are deemed valid and reliable.

RESULT AND DISCUSSION

In this research, the validity test was carried out by considering the value of convergent and discriminant validity. Assessment of the validity of the instrument is done through the analysis of the value of the factor load

(factor loading) in the measurement model. An indicator item is considered necessary to be excluded from the model if its factor charge value is less than 0.7. The results of the analysis showed that each variable in this research has a factor load value that exceeds the recommended threshold, which is 0.7.

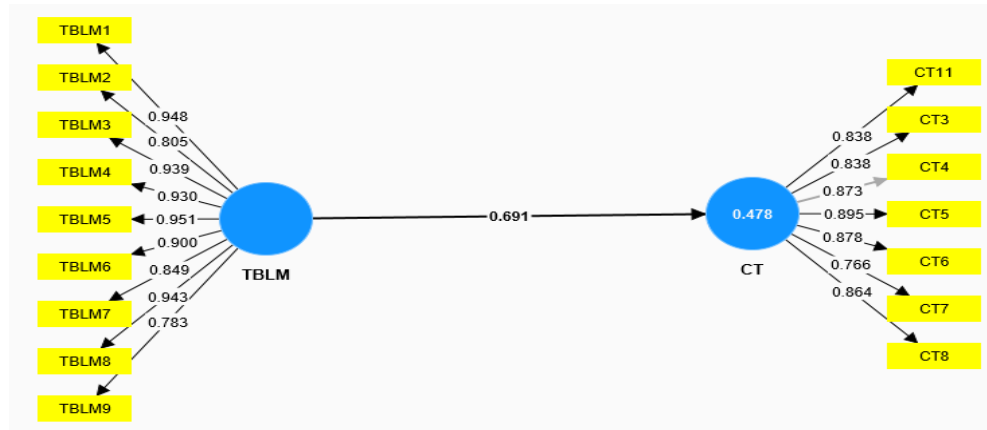


Figure 2. Outer Model Output View

Figure 2 and Table 3 demonstrate that convergent validity has been achieved since all loading factor values for each indicator exceed 0.7. Several indicators with a loading factor value below 0.7 were excluded from the model, resulting in 9 indicators for the technology-based learning variable and seven indicators for the critical thinking variable. The variable of critical thinking exhibits the lowest loading factor, precisely 0.766. The results affirm the validity of the indicators employed in this research and their adherence to the norms of convergent validity. To evaluate discriminant validity, it is necessary to consider the square root of the average variance extracted (AVE) value. The recommended value is 0.5 or higher (Hair et al., 2018).

Table 3. Factor Loadings (FL), Average Variance Extracted (AVE)

Construct	Items	FL	AVE
Technology-Based Learning Model	TBLM1	0,948	0,803
	TBLM2	0,805	
	TBLM3	0,939	
	TBLM4	0,930	
	TBLM5	0,951	
	TBLM6	0,900	
	TBLM7	0,849	
	TBLM8	0,943	
	TBLM9	0,783	
Critical Thinking	CT3	0,838	0,725
	CT4	0,873	
	CT5	0,895	
	CT6	0,878	
	CT7	0,766	
	CT8	0,864	
	CT11	0.838	

The discriminant validity test can be assessed using the Fornell-Larcker criterion, which measures discriminant validity at the construct level.

Table 4. Discriminant Validity

	Critical Thinking	Technology-Based Learning Model
Critical Thinking	0,851	
Technology-Based Learning Model	0,691	0,896

The table displayed above presents the outcomes acquired from the validity assessment. The square root values of AVE (0.851 and 0.691) are both more than 0.5 for each build or AVE root value. The computations yield an Average Value of Effect (AVE) for each variable that exceeds 0.5, as reported by (Shiau et al., 2019). The Fornell measurement model, often referred to as the outer model, is regarded as valid due to its fulfillment

of the criteria of convergent validity and discriminant validity (Fornell & Larcker, 1981).

Table 5. Reliability Test

	Cronbach's Alpha	Composite Reliability
Critical Thinking	0.936	0.941
Technology-Based Learning Model	0.969	0.974

The Cronbach's alpha analysis results indicate that the two research variables exhibit values ranging from 0.936 to 0.969, suggesting a high level of reliability for all of these variables. When all constructs have values over 0.7, and the SmartPLS output yields result beyond 0.9, the reliability test can be enhanced by including Cronbach's alpha as a measure of consistency. Furthermore, this research employed the SmartPLS program to conduct a similarity test. This can be observed through the reliability values of construct variables' indicators, which are a specific sort of reliability value utilized for assessing the dependability of variable indicators. Values over 0.7 in this test are regarded as being in close proximity to the average (Hair & Sarstedt, 2021). Once the test model has been confirmed to possess both validity and reliability, without any issues or concerns regarding the accuracy and consistency of the results, the process of conducting structural model testing can commence. This test is designed to assess both hypotheses and correlations between variables. The assessment of the structural model (inner model) in PLS can be observed using the R-square value, as presented in the table below:

Table 6. R-Square Value

Construct	R-Square	R-Square Adjusted
Critical Thinking	0,478	0,476

Based on the analysis of data that has been done, it was found that the value of R for critical thinking variables is 0.478. This indicates that about 47.8% of the variation in critical thinking skills can be explained by the application of technology-based learning models. Meanwhile, the remaining 52.2% were likely influenced by other factors that were not covered by this research model. The path coefficient is utilized as a reference in hypothesis testing to evaluate the structural model during the bootstrapping phase by examining the original number (β), T-statistics, and P-value displayed in the table below.

Table 7. Hypothesis Testing Result

		Original Sample	T-Statistics	P-Value
Technology-Based Learning Model ➡	Critical Thinking	0,691	18,134	0,000

The hypothesis of this research proposes that the use of technology-based learning models has a positive influence on the development of critical thinking skills. Analysis of the data carried out using the SmartPLS 4.0 software resulted in an original sample value of 0.691, which indicates a positive effect. Furthermore, a statistical t-value of 18.134 was obtained, which exceeded the critical value of 1.96 at a significance level of 5%. In addition, the resulting p-value is 0.000, which is below the threshold of 0.001. Therefore, the learning paradigm based on technology has a substantial and favorable impact on critical thinking skills, thereby confirming this theory.

The validity test result confirms that the instrument has a high validity value, exceeding 0.7, which shows its fitness for usage. The instrument utilized in this research must possess both reliability and validity. The results of this research demonstrate that the instrument employed is indeed dependable, as indicated by a value exceeding 0.5. The results of the hypothesis test presented in Table 7 indicate that technology-based learning exerts a beneficial impact on the critical thinking skills of students attending boarding schools. The results indicate a significant positive impact of technology-based learning on students' critical thinking in boarding school. This is supported by the coefficient value (β) of 0.691, the T-statistic value of 18.134, and the P-value of 0.000, which is less than 0.05. Based on these results, this research demonstrates that critical thinking has a statistically significant impact on technology-based learning. Therefore, the results of this research align with Rakshit et al. (2021), demonstrating that possessing critical thinking skills enables individuals to recognize and assess potential issues, as well as explore and analyze alternative solutions. This ability is particularly beneficial for students engaged in technology-based learning during the digital age. This is because students who possess the ability to engage in critical thinking will have the capacity to formulate effective approaches to navigate technology-driven education in the modern day. Individuals who possess proficient critical thinking skills might engage in endeavors that necessitate contemplative thought as well. A critical thinker utilizes analytical and deductive reasoning abilities. Individuals who possess the ability to engage in critical thinking will generate a more significant number of ideas and assumptions compared to those who accept information

without question. Consequently, the process of learning becomes more dynamic and participatory rather than passive. This result supports [Prasanna et al. \(2019\)](#). An individual's ability to generate innovative ideas and tangible output, either independently or in collaboration with an existing group, might enhance students' critical thinking skills, mainly when dealing with technology-driven education in the digital age. With an increasing number of countries aiming to enhance educational technology and modernize classrooms, it is crucial to prioritize the improvement of infrastructure, accessibility to devices and content, and teacher involvement. Currently, students and instructors may have acquired access to a diverse range of novel digital content. These encompass interactive webpages, augmented reality, educational games, and personalized instruction. An advantage of electronic learning is that it grants students increased autonomy over their curriculum, enabling them to acquire knowledge in their preferred manner and at their desired rate of cognitive analysis ([West, 2013](#)).

This research has similarities with [Karuru et al. \(2024\)](#) in terms of the use of technology to improve students' critical thinking skills. However, this research focuses on boarding school students, while [Karuru et al. \(2024\)](#) explore student education. Both studies found positive impacts of technology-based learning. The main difference is in the research method used in this research, which uses a quantitative approach, while [Karuru et al.](#) use qualitative methods that provide a deeper picture of the student's experience. For future research, the combination of quantitative and qualitative methods could provide a more complete understanding of the effectiveness of technology-based learning in improving critical thinking skills in various types of educational institutions. In addition, students can readily and effortlessly retrieve diverse information owing to technology. Utilizing technology for learning purposes can facilitate the enhancement of students' analytical and evaluative abilities by considering several perspectives and utilizing diverse sets of data. Nevertheless, it is crucial to note that robust instructional design and instructor support are equally vital in enhancing the efficacy of technology in enhancing students' critical thinking skills. Strategic implementation of technology in the classroom is essential to optimize the advantages of fostering students' critical thinking skills.

CONCLUSION

Based on the research and analysis of these data, the implementation of technology-based learning models in boarding schools to improve students' critical thinking skills can be concluded. Involving 298 students from a boarding school in Yogyakarta and using a quantitative methodology, this research assessed the impact of technology on critical thinking skills. The results suggest that technology-based learning has a positive impact on students' critical thinking skills. The research emphasizes the importance of integrating technology in education to improve students' critical thinking skills, as well as supporting previous research on the benefits of technology in improving critical thinking skills. The implication of this research is the need for increased use of technology in education to strengthen students' analytical and evaluative abilities. It confirms that technology-based learning approaches can be an effective means of improving students' critical thinking skills in boarding schools.

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