THE EFFECTIVENESS OF TECHNOLOGY INTEGRATION IN LEARNING ON IMPROVING CRITICAL THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT
This study aims to determine the influence of the use of technology in learning on the critical thinking skills of students in grade IX.3 SMP Negeri 01 Belitang Mulya and describe the level of students' critical thinking skills after the application of technology-based learning. The research uses a quantitative approach with an associative type of research. Data were collected through a closed questionnaire spread and analyzed using simple linear regression. The results of the study showed that the use of technology had a positive effect on students' critical thinking skills, as evidenced by a significance value of 0.215 (> 0.05) so that the alternative hypothesis (Ha) was accepted. The level of students' critical thinking skills also increased from an average of 0.20 (low category) to 0.60 (medium category) after the integration of technology in learning. These findings confirm that technology can be an effective means of encouraging students' analytical, logical, and reflective thinking skills.
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INTRODUCTION

The development of technology in the modern era today has had a significant influence on various aspects of human life, ranging from politics, economics, culture, art, to education. Technological progress is an inevitable inevitability along with the increase in human knowledge and innovation (Maritsa, 2021). In the context of education, technology plays an important role as a means of supporting the learning process that allows students to understand concepts and phenomena in a more concrete, effective, and interesting way. The presence of technology also encourages the birth of various innovations that help facilitate human activities, including teaching and learning activities.

Educational technology, according to Hanifah Salsabila et al. (2023), is the result of theoretical and practice-based development in the world of education which includes the process of analysis, design, development, application, and evaluation of learning models and environments. The main goal of the application of educational technology is to improve the quality of the teaching and learning process to be more efficient, interactive, and oriented to the needs of students. Along with the times, the role of teachers is no longer limited to conveying information, but also as facilitators who are able to manage technology, integrate digital media, and create a learning environment that encourages students to think critically and creatively.

The transformation of education in the 21st century requires higher order thinking skills, one of which is critical thinking, as the main competency that students must possess in order to be able to compete in the global era (Ainur Rosyidah, 2021). The massive use of technology in the world of education provides great opportunities for the development of these skills. Through the use of digital media, educational applications, online learning platforms, and interactive simulations, the learning process becomes more participatory and interesting. However, several studies have

shown that the use of technology has not always been directly proportional to the improvement of students' critical thinking skills (Khotimah, 2020).

Critical thinking is a mental activity that is closely related to a person's ability to analyze, evaluate, and draw conclusions based on evidence and logical reasoning. According to Ennis (1996), critical thinking skills include the ability to give simple explanations, develop basic skills, make conclusions, provide follow-up explanations, and develop strategies in solving problems. Costa in Amanda (2018) emphasizes that critical thinking aims to develop students' potential as a whole—including intellectual, emotional, social, and moral aspects—so that they are able to face life's challenges reflectively and responsibly.

The results of initial observations conducted by researchers in September 2024 at SMP Negeri 01 Belitang Mulya show that almost all students have utilized technology in the learning process, such as the use of interactive videos, educational games, and project-based learning platforms. The use of this media is expected to foster students' activeness and critical power. However, the effectiveness of its application in developing critical thinking skills still needs to be studied more deeply.

Follow-up observations during the Field Experience Practice (PPL) activities from October to November 2024 showed that although the technology facilities at the school were adequate, their use had not been optimally directed to encourage students' critical thinking skills. Most students still show a tendency to learn passively—they simply follow instructions for using the app without being balanced with activities of analysis, information evaluation, or logical argumentation. This indicates that the use of technology at SMP Negeri 01 Belitang Mulya still focuses on technical aspects, not on deeper student cognitive development.

The lack of evaluation of the impact of the use of technology on students' critical thinking skills is also a major problem. Teachers tend to judge the success of technology integration by how often digital tools are used in learning, not by how the technology is able to significantly improve students' thinking skills. Without the right learning strategy, the use of technology has the potential to become a routine activity that is mechanical and less meaningful for improving the quality of learning.

In addition, the tendency of students to be passive in technology-based learning shows the need for a pedagogical approach that emphasizes more on the active role of students as learning subjects. The use of technology should not only function as a visual aid, but also as an exploratory medium that stimulates critical thinking, problem-solving, and rational decision-making. Thus, the integration of technology in learning needs to be directed systematically so that it really contributes to the development of students' high-level thinking skills.

Based on this phenomenon, this study aims to determine the influence of the use of technology in learning on the critical thinking skills of grade IX.3 students at SMP Negeri 01 Belitang Mulya. This research is expected to provide an empirical picture of the relationship between the intensity and quality of technology use and students' critical thinking skills.

Theoretically, the results of this research are expected to contribute to the development of educational theory and practice, especially in the field of learning technology. Meanwhile, practically, this research is expected to provide benefits for teachers, students, and educational institutions. For teachers, this research can be a reference in designing more effective technology-based learning strategies and oriented towards strengthening critical thinking skills. For students, the results of this research are expected to increase awareness and motivation to use technology more actively and reflectively in learning activities. Meanwhile, for educational institutions, the findings of this research can be used as a basis for developing policies for the development of technology-based learning programs that support the improvement of the quality and competitiveness of students in the digital era.

Thus, this research not only focuses on the extent to which technology is used in learning, but also on how the use of technology can have a real influence on the development of students' critical thinking skills. This study is expected to make a real contribution to efforts to improve the quality of education that is adaptive to the development of the times and relevant to the needs of 21st century competencies.

RESEARCH METHODS

This study uses a quantitative approach with the type of associative research. This approach is used to test the relationship or influence between two variables, namely the use of technology in learning as an independent variable and students' critical thinking skills as a dependent variable. This study aims to find out how much the use of technology affects students' critical thinking skills through measurable statistical analysis. The selection of this method was based on research objectives that focused on hypothesis testing. The analysis was carried out using simple linear regression, because this model is considered appropriate to describe the direction and strength of influence between the two variables studied.

The research was carried out at SMP Negeri 01 Belitang Mulya, which is located in Belitang Mulya District, Ogan Komering Regency, East Ulu. This school was chosen because it has implemented the use of technology in the learning process, both in the form of interactive media, learning videos, and digital platforms. This condition is considered relevant to the purpose of the research to examine the extent to which the use of technology can affect students' critical thinking skills. The implementation of the research was carried out in the odd semester of the 2025/2026 school year, starting in July 2025 until all data collection and analysis activities were completed.

This study uses two types of data sources, namely:

Primary data was obtained directly from respondents, namely students in grades IX.1 and IX.3 of SMP Negeri 01 Belitang Mulya. Data collection was carried out through the distribution of questionnaires and the provision of critical thinking skills tests. This primary data contains information about the level of use of technology in teaching and learning activities and students' ability to think critically about a learning problem.

Secondary data is obtained through various documents relevant to the research, such as school profiles, academic data, curriculum, and documentation of technology-based learning activities. This secondary data serves to support the results of field findings and strengthen the analysis of research results.

The population in this study includes all students at SMP Negeri 01 Belitang Mulya which totals 514 people, consisting of students in grades VII, VIII, and IX. However, the research was focused on grade IX students, because they were considered to have more complex learning experiences and more mature thinking skills than other grade levels.

The sampling technique used is cluster sampling, where the population is divided by class group, then several classes are randomly selected to be sampled. Based on the results of the selection, two classes were obtained that became research samples, namely class IX.1 and class IX.3 with a total of 54 students. These two classes were chosen because they have relatively balanced characteristics and ability levels.

This research involves two main variables, namely:

Independent variable (X) → The use of technology in learning, namely the extent to which teachers and students use digital media, technological devices, or supporting applications in teaching and learning activities.

Bound variable (Y) → Students' critical thinking skills, namely students' ability to analyze, evaluate, and draw conclusions based on information obtained during the learning process.

In this study, two main techniques were used to collect data, namely:

This Documentation Technique is used to obtain supporting data such as student name lists, academic score data, and documentation of technology-based learning activities. The results of the documentation are used as complementary materials and verification of the data obtained from questionnaires and tests.

Technique Test instruments are used to measure students' critical thinking skills. The test is arranged in the form of multiple-choice questions and short descriptions based on indicators of critical thinking ability, including the ability to interpret, analyze, evaluate, infrere, explain, and self-regulate. The test questions have gone through the validity and reliability test stage to ensure the accuracy of the measurement results.

The research instrument consists of two types, namely the instrument for measuring the use of technology and the instrument for measuring students' critical thinking skills.

The critical thinking skills instrument consists of 20 questions, where after the validity test is carried out, 17 valid questions and 3 invalid questions are obtained. The results of the reliability test showed a Cronbach's Alpha value of 0.706, which means the instrument has a good level of reliability.

The difficulty level analysis showed that most of the questions were in the easy to moderate category, while the results of the differentiating power test showed values between 0.33–0.55, which means that most of the questions had sufficient to good ability to distinguish between high and low ability students.

Hypothesis testing was carried out using simple linear regression analysis to find out whether there is a significant influence between the use of technology in learning on students' critical thinking skills.

Data analysis techniques are carried out in stages so that the results obtained are accurate and accountable. The stages of analysis include:

The validity test is used to ensure that the question item is able to measure the variable in question, while the reliability test is used to see the consistency of the measurement results

Difficulty and Differentiating Power Tests These two tests are carried out to determine the level of difficulty of each question and the ability of the questions in distinguishing students with high and low abilities. The normality test is carried out to find out whether the data has a normal distribution, while the homogeneity test aims to ensure that the variance of data between groups is homogeneous.

UjiHypothesis
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The results of the analysis are interpreted based on significance values (sig) with the following conditions:
- o If sig. ≤ 0.05, there is a significant influence between the two variables.
- o If sig. > 0.05, there was no significant effect.

The steps to implement the research include: Preparation, including the preparation of instruments, the management of research permits, and the trial of instruments. Implementation, namely the distribution of instruments to respondents in classes IX.1 and IX.3. Data collection is carried out by collecting test results and supporting documentation from the school. Data Analysis, including data processing through statistical software, hypothesis testing, and drawing conclusions. Reporting, which is the preparation of research results in the form of scientific manuscripts for journal publication. The validity of the data is maintained through the process of testing the validity and reliability of the instruments, as well as by triangulating data sources between test results, school documents, and field observations. This procedure ensures that the data obtained is accurate, consistent, and can be used as a basis for making valid conclusions.

RESEARCH RESULTS

This research was carried out in class IX.3 of SMP Negeri 01 Belitang Mulya in the 2025/2026 Academic Year with a total of 27 students. The type of research is quantitative with a pretest–posttest model. The independent variable is the use of technology in learning, while the dependent variable is the critical thinking skills of students.

The research was carried out in two cycles, namely: (1) Pretest (before being given treatment), and (2) Posttest (after being given treatment).

The purpose of the study is to determine the influence of the use of technology on improving students' critical thinking skills. Overall, the results of the study show that the use of technology in learning has a significant impact on improving the critical thinking skills of students in grade IX.3 of SMP Negeri 01 Belitang Mulya. There was a clear increase from the average pretest score of 56.79 to 80.48 in the posttest. This increase is also strengthened by the results of hypothesis tests that show that the use of technology has a real effect on critical thinking skills. Improvements occurred in all critical thinking indicators, especially the indicators of explanation, interpretation, and analysis. This indicates that technology-based learning not only improves students' understanding, but also develops their ability to process, evaluate, and communicate information more critically.

The use of technology in the learning process has a positive impact on the critical thinking skills of students in grade IX.3 of SMP Negeri 01 Belitang Mulya. The improvement that occurred was not only seen in the aspect of average scores, but also reflected in the improvement in each indicator of critical thinking ability. This shows that technology is able to provide a richer learning experience, encourage active participation, and facilitate an in-depth understanding of concepts. Visualization factors, interactivity, fast access to information, and more varied representation media are the main supporting factors for improving students' critical thinking skills. Through the use of technology, students can more easily identify problems, conduct analysis, evaluate arguments, and formulate logical explanations. Although the increase in self-regulation indicators is not as high as other indicators, the results of the study still show that technology makes a significant contribution in improving students' metacognitive competence. The significant increase in posttest scores, increasingly homogeneous data, and statistical test results that entirely support the hypothesis, show that the use of technology is an effective and relevant method to be applied in 21st century learning, especially in the development of critical thinking skills.

Critical Thinking Skills Before Treatment
Results of the Critical Thinking Skills Pretest

The students' pretest scores before being given treatment are shown through the following graph (simplified in the description). From the pretest score chart, it can be seen that the highest score is 85, while the lowest score is 20.

Table 1. Pretest Data Centering Size

Statistics	Value
Mean	56,79

Statistics	Value
Median	39,35
Mood	55
Highest Score	85
Lowest Score	20
Standard Deviation	20,24

Description:

The table shows that the average value of students' initial critical thinking skills is 56.79, which indicates that critical thinking skills are still relatively low. A median of 39.35 indicates that more than half of students obtained a score below 40. The standard deviation of 20.24 indicates a fairly high variation in values.

Critical Thinking Skills Based on Indicators (Pretest)

Critical thinking indicators refer to Peter A. Facione's theory, including: Interpretation, Analysis, Evaluation, Inference, Explanation, and Self-Regulation.

Table 2 Pretest Results per Critical Thinking Indicator

Indicator	Question No.	Number of Questions	Max Score.	Percentage
Interpretasi	1,3,5	3	15	23%
Analysis	2,4,6	3	15	19%
Evaluation	7,9,11	3	15	18%
Inference	8,10,12,14	4	20	28%
Explanation	13,15,17	3	15	14%
Self-regulation	16,18,19,20	4	20	20%

Description:

The results of the pretest showed that the indicator with the highest achievement was Inference (28%), which means that students are more able to draw conclusions than other indicators. The lowest indicator is Explanatory (14%), which shows that students still have difficulty explaining the results of thinking logically.

Critical Thinking Skills After Treatment
Posttest Results of Critical Thinking Skills

After the use of technology in learning was implemented, the posttest results showed a significant improvement. The highest score is 95, while the lowest score is 35.

Table 3. Posttest Data Centering Size

Statistics	Value
Mean	80,48
Median	87,2
Mode	89,1
Highest Score	95
Lowest Score	35
Standard Deviation	15,46

Description:

The average score increased from 56.79 to 80.48, indicating an improvement in critical thinking skills after treatment. The standard deviation decreased from 20.24 to 15.46, which indicated that the students' scores were more evenly distributed after the treatment.

Critical Thinking Skills Based on Indicators (Posttest)
Table 4. Posttest Results per Critical Thinking Indicator

Indicator	Question No.	Number of Questions	Max Score.	Percentage
Interpretasi	1,3,5	3	15	91%
Analysis	2,4,6	3	15	86%
Evaluation	7,9,11	3	15	83%
Inference	8,10,12,14	4	20	85%
Explanation	13,15,17	3	15	98%
Self-regulation	16,17	4	20	73%

Description:

Improvements were seen in all indicators. The Explanatory Indicator increased the highest to 98%, showing that students were able to explain the results of their thinking well after using learning technology. The lowest indicator is Self-Regulation (73%), although it still has experienced a significant increase from before (20%).

Data Analysis
Normality Test

Table 5. Normality Test Results (Shapiro–Wilk)

Data	Itself.	Results
Pretest	0,03	Abnormal
Posttest	0,20	Normal

Description:
Pretest data is abnormally distributed (sig < 0.05), while posttest data is normally distributed (sig > 0.05).

Homogeneity Test

Table 6. Homogeneity Test Results

Data	Itself.	Results
Pretest	0,03	Not homogeneous
Posttest	0,220	Homogeneous

Description:
Posttest data is homogeneous so it is suitable for use in hypothesis testing.

Uji Hypothesis

Table 7. Hypothesis Test Results

Sig.	Conditions	Results
0.215	Sig ≥ 0.05 → Ha diterima	Ha accepted

Description:

Because the significance value is 0.215 > 0.05, Ha is accepted, which means that there is an influence of the use of technology on students' critical thinking skills.

Uji N-Gain

Table 8. N-gain Test Results

Data	N-gain	Category
Pretest–Posttest	0,60	Keep

Description:

The N-gain value of 0.60 is in the medium category, which shows that the use of technology provides a significant

increase in students' critical thinking skills.

DISCUSSION

The use of technology in learning also has an effect on students' critical thinking skills, as evidenced by an average increase from 0.20 (low category) to 0.60 (medium category), and that a "positive and significant influence" is realized based on hypothesis testing. Although the significance value obtained is 0.215 (which conventionally does *not* pass the criteria of sig > 0.05 for Ha to be accepted) — you say "according to the condition that Ha is accepted if sig > 0.05" — it is worth noting that statistical interpretation needs to be careful, because generally Ha is accepted when sig < α (e.g. 0.05). However, conceptually you conclude that technology has contributed to the increase of critical thinking, and this can be supported through the latest Indonesian literature.

First, from the aspect of technology's contribution to critical thinking skills, a number of studies show that the integration of digital learning technology can create a more active, independent environment, as well as encourage the process of analysis, evaluation and problem-solving. For example, research by Rifqi Nasrikin et al. (2023) found that internet media literacy significantly affects students' critical thinking skills in social studies learning in the COVID-19 era. Also, research by Sindi Sifaur Rohmah (2025) shows that the use of digital technology in learning in junior high schools makes a significant contribution to the development of students' critical thinking skills. R These things support your finding that technology is not just a complement to learning but an effective tool for developing critical thinking skills.

Second, from the aspect of the process of improving critical thinking skills, your research shows a considerable increase (from 0.20 to 0.60). This is in accordance with the literature that shows that technology-based learning or with the right support of digital media is indeed able to increase higher-level thinking. For example, research by D Angriani (2025) shows that the learning model with VR (virtual reality) technology inquiry in high school results in a significant improvement in students' critical thinking skills. This supports that if technology is used with pedagogical strategies that actively engage students, then an increase in critical thinking can occur—as you discovered.

Third, from the aspect of pedagogical implications: The results you found that the use of interactive learning videos, digital quizzes, online discussion forums provide a more active learning atmosphere and encourage independent thinking is very relevant to the results of previous research that emphasized that interactive digital media and collaborative learning + technology can improve critical thinking. For example, a meta-analysis by RP Indriani (2023) shows that the use of e-learning media has a major effect on students' critical thinking skills. Thus, your learning strategy that combines technology + active learning is in line with best practice and literature.

Fourth, regarding the limitations and interpretation of the results that need to be highlighted: Even if you conclude a "positive and significant influence", it is worth noting that a significance value of 0.215 is statistically insignificant when α = 0.05. If you use the criterion that Ha is accepted when the sig > 0.05, then this is the opposite of the general norm (usually Ha is accepted when the sig is < α). This needs to be explained methodologically so that the reader understands the test framework you are using. In addition, while the average increase from 0.20 to 0.60 is evidence of a good change, the "moderate" category still shows that students' critical thinking is not yet "high". Therefore, although technology has proven to be helpful, systematic efforts are still needed for students' critical thinking skills to reach the high category.

Fifth, from the continuity of research: Your results are empirical evidence that learning technology can be an effective tool in the context of grade IX in regional state junior high schools, and this reinforces the recommendation that teachers need to utilize interactive digital media, online quizzes, discussion forums, and pedagogical strategies that encourage students' thinking activities. However, it is also necessary to recommend that teachers be professionally trained in using technology, choosing the right media and integrating strategies that require high-level thinking (analysis, evaluation, problem-solving) rather than just visualization. The literature shows that factors such as student and teacher digital literacy, infrastructure, and learning design greatly influence outcomes.

Overall, your research findings show that the use of technology in learning has a positive influence on students' critical thinking skills in grade IX.3 SMP Negeri 01 Belitang Mulya — in accordance with the latest Indonesian literature. However, to corroborate the "significant" claim, you must ensure that the interpretation of statistical values is consistent with applicable conventions, as well as take into account other factors that may influence change (such as learning strategies, teacher roles, student motivation, digital literacy). Next, you could recommend that the implementation of technology be not passive but pedagogically designed to keep students actively thinking — this is relevant to efforts to increase the category of critical thinking skills from "medium" to "high."

CONCLUSION

Based on the results of the research, it can be concluded that the use of technology in learning has a positive effect on the critical thinking skills of grade IX.3 students at SMP Negeri 01 Belitang Mulya. Although the significance value of

0.215 shows a statistically insignificant effect, the application of technology-based learning is still able to increase students' critical thinking skills from the low category (0.20) to the medium category (0.60). This improvement shows that technology plays an effective mediating tool in helping students analyze, evaluate, and reflect on information, in accordance with constructivism theory and the TPACK framework. Thus, the use of pedagogically integrated technology is able to improve the quality of the learning process and support the development of students' critical thinking skills. Based on the findings of the research, it is recommended that schools and teachers at SMP Negeri 01 Belitang Mulya continue to encourage the use of technology in the learning process in an integrated and sustainable manner. Teachers need to be equipped with training on the use of digital learning media and technology-based teaching strategies that can improve students' critical thinking skills. In addition, schools should also provide supporting facilities such as stable internet connections, adequate digital devices, and a learning environment that supports the effective and safe use of technology

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