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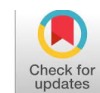
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Influence of Digital Literacy on the Critical Thinking Ability of Mathematics Education Students in Evaluating Digital Information

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ABSTRACT

Students' critical thinking skills in assessing digital information have not yet developed optimally. This study aims to analyze the relationship between digital literacy and the critical thinking ability of mathematics education students in evaluating digital information. The research employed a quantitative approach with a correlational design. The participants consisted of 120 students from the Department of Mathematics Education at Universitas Negeri Makassar, selected through purposive sampling. The research instruments included a digital literacy questionnaire measuring aspects of access, evaluation, verification, and utilization of digital information, as well as a critical thinking test assessing information analysis, source credibility evaluation, information verification, and conclusion drawing. The validity test results indicated that all instrument items had validity coefficients above 0.30 and were therefore considered valid, while the reliability test results showed Cronbach's Alpha values of 0.87 for the digital literacy questionnaire and 0.82 for the critical thinking test, indicating that both instruments were reliable. Data were analyzed using descriptive statistics and simple linear regression analysis. The findings revealed that students' digital literacy was categorized as high, whereas their critical thinking ability was categorized as moderate based on the predetermined score intervals. Regression analysis demonstrated that digital literacy had a positive and significant predictive relationship with students' critical thinking ability ($\beta = 0.48$; $p < 0.001$), contributing $R^2 = 0.32$. This study recommends integrating digital literacy into mathematics learning through activities involving source evaluation, information analysis, and evidence-based argumentation to support the development of students' critical thinking skills.



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Introduction

The rapid development of digital technology over the last two decades has significantly reconstructed the way individuals access, process, and utilize information. This transformation has not only affected social and economic aspects but has also generated broad implications in the field of education, particularly in information-based learning practices (Haniko et al., 2023; Rany et al., 2025). In this context, university students, as part of a generation living within a digital ecosystem, are confronted with an overwhelming amount of information available through various platforms such as search engines, social media, and online repositories. The massive availability of information requires not only the ability to access information but also the cognitive capacity to critically evaluate the quality, accuracy, and credibility of information. Various international reports indicate that increased access to information is not always accompanied by adequate evaluative abilities, causing individuals to become vulnerable to misinformation and disinformation circulating in digital spaces (Berta Dinata, 2021; Dwiki Darmawan et al., 2025).

This phenomenon is also reflected in the national context, where university students are often assumed to possess high digital literacy due to the intensity of their interaction with technology. However, this assumption is not fully supported by empirical findings. Several studies indicate that students' digital literacy skills remain largely limited to operational aspects, while their ability to critically evaluate digital information has not yet developed optimally. Students tend to accept information without conducting systematic verification, potentially resulting in misunderstandings, including within academic domains such as mathematics. This condition becomes crucial considering that mathematics, as a discipline, demands logical precision, conceptual consistency, and profound analytical ability. The inability to critically evaluate digital information may lead to persistent misconceptions and hinder meaningful learning processes (Berta Dinata, 2021; Rany et al., 2025).

Among students of the Department of Mathematics Education at Universitas Negeri Makassar, these issues have also begun to emerge in students' academic activities. Based on preliminary observations and discussions with several lecturers teaching mathematics courses, some students were found to use digital sources without verifying the correctness of the mathematical concepts and procedures presented. Students frequently adopt problem-solving methods from social media, educational videos, or online websites without evaluating the validity of the solution procedures or the accuracy of the concepts provided. Some students also experience difficulties distinguishing between credible mathematical information sources and sources containing inappropriate conceptual simplifications. These conditions indicate that students' digital literacy and critical thinking abilities in evaluating digital mathematical information still need to be strengthened, particularly because mathematics education students are prepared to become future teachers who will convey mathematical concepts to learners.

In responding to these issues, digital literacy is regarded as an essential competency that university students must possess. Digital literacy is not merely understood as the technical ability to operate digital devices and applications, but also as a cognitive ability encompassing the processes of understanding, analyzing, evaluating, and producing information responsibly (Rochmatika & Yana, 2022; Rosalina et al., 2023; Xiao et al., 2026). Individuals with high levels of digital literacy are expected to be capable of identifying credible information sources, understanding information contexts, and critically assessing the validity and relevance of information. Within this conceptual framework, digital literacy is closely associated with critical thinking ability, which constitutes one of the primary components of Higher Order Thinking Skills (HOTS) (Rosyida & Bahtiar, 2024; Sutamrin & Khadijah, 2021).

Critical thinking, as a higher-order cognitive ability, involves a series of complex mental processes, including analysis, evaluation, inference, and logical conclusion drawing (Susanti et al., 2024; Weigelt et al., 2026; Xiao et al., 2026). In mathematics learning, critical thinking plays a strategic role in helping students understand concepts deeply, solve problems systematically, and evaluate the correctness of procedures or solutions. Furthermore, critical thinking also contributes to students' ability to assess the validity of mathematical information obtained from various digital sources. Therefore, the development of critical thinking skills is not only relevant within the context of mathematical problem-solving but also within the broader context of information literacy in the digital era.

Several previous studies have examined the relationship between digital literacy and critical thinking ability. Research findings indicate that digital literacy contributes positively to the enhancement of critical thinking skills among students at both school and university levels. Individuals with strong digital literacy tend to possess higher abilities in identifying relevant information, evaluating information sources, and making decisions based on rational considerations (Behnamnia et al., 2025; Cheng & Weatherly, 2025; Mansour et al., 2026; Saig & Hershkovitz, 2024). Nevertheless, most of these studies remain general in nature and have not specifically investigated the relationship between digital literacy and critical thinking within the context of mathematics education. In addition, previous studies have predominantly emphasized aspects of technology utilization without deeply examining the cognitive processes involved in evaluating digital information (Mendoza Diaz et al., 2025).

On the other hand, the increasing use of digital learning resources is not always accompanied by adequate information quality. Numerous digital contents contain conceptual errors, inappropriate simplifications, and even academically invalid information. In this context, the ability to critically evaluate digital information becomes highly important, especially for mathematics education students who are expected to demonstrate accuracy in understanding and evaluating concepts (Mas Ramadhan et al., 2021). However, studies that simultaneously integrate digital literacy, critical thinking, and the ability to evaluate digital information within the context of mathematics education remain limited. This condition indicates a significant research gap, particularly in understanding how digital literacy contributes to students' critical thinking ability in evaluating digital information.

Based on the explanations above, this study offers novelty by positioning digital literacy as a predictor of mathematics education students' critical thinking ability in evaluating digital mathematical information. This research not only examines the relationship between variables in general but also emphasizes the process of evaluating digital information related to mathematical concepts, procedures, and reasoning that may contain inaccuracies, such as procedural errors in problem-solving, invalid formula usage, or inaccurate explanations of geometric concepts presented in digital media. In this study, digital literacy is understood as a multidimensional ability encompassing the skills to access, evaluate, verify, and utilize digital information critically, while critical thinking ability includes aspects of information analysis, source credibility evaluation, bias identification, information verification, and conclusion drawing.

Therefore, this study aims to analyze the predictive relationship between digital literacy and the critical thinking ability of mathematics education students in evaluating digital mathematical information. Theoretically, digital literacy is positioned as a predictive variable because the ability to access and evaluate digital information is assumed to support students' critical thinking processes in understanding and verifying mathematical information obtained from digital media. This study is expected to provide theoretical contributions to the development of research on digital literacy and critical thinking, as well as practical

contributions in designing mathematics learning activities based on information searching, source evaluation, information analysis, and evidence-based argumentation so that prospective mathematics teachers are able to critically and responsibly evaluate digital information.

Method

Research Design

This study employed a quantitative research approach with an associative (correlational) design aimed at examining the relationship and influence between digital literacy and the critical thinking ability of mathematics education students in evaluating digital information. A correlational approach was selected because the study did not involve any experimental treatment; rather, it focused on measuring the relationships among variables as they naturally occurred. In addition, this approach enabled the researchers to identify the contribution of digital literacy to students' critical thinking ability.

Population and Sample

The population of this study consisted of all active students of the Department of Mathematics Education, Department of Mathematics, Universitas Negeri Makassar, during the 2025/2026 academic year. The population included students from several semester levels who generally had experience utilizing digital technology as a learning resource, making them relevant to the focus of the study concerning digital literacy and critical thinking ability. The research sample was determined using purposive sampling, a sampling technique based on specific criteria relevant to the objectives of the study. This technique was selected because the exact population size could not be identified in detail; therefore, a non-probability sampling approach was considered more appropriate. Furthermore, purposive sampling allowed the researchers to select respondents who possessed characteristics aligned with the needs of the study, particularly regarding experience in using digital information. The sample criteria in this study were as follows: (1) active students of the Department of Mathematics Education at Universitas Negeri Makassar; (2) students who had completed at least one semester of study; and (3) students who had experience accessing digital information for academic purposes. Based on these criteria, a total of 120 students met the requirements and were selected as research respondents. Demographically, the respondents were between 18 and 23 years of age and demonstrated relatively high levels of access to digital technology. This condition was reflected in the intensive use of the internet for academic activities, such as searching for references, accessing learning materials, and utilizing various digital platforms. These characteristics indicate that the respondents had sufficient experience interacting with digital information, making them relevant subjects for investigating their ability to critically evaluate digital information.

Instruments

The instruments used in this study consisted of two types: a digital literacy questionnaire and a critical thinking skills test. Both instruments were developed based on relevant theoretical frameworks to ensure that the research constructs were measured validly and reliably.

Digital Literacy Questionnaire

The digital literacy questionnaire was developed based on the concept of digital literacy as a multidimensional competence encompassing cognitive, evaluative, and ethical aspects in interacting with digital information. In this study, digital literacy was not merely understood as the technical ability to operate digital devices, but also as the ability to access, understand, evaluate, and utilize information critically and responsibly. Based on this framework, the indicators of digital literacy measured in this study included access to digital information, understanding of digital information, evaluation of digital information, and ethical use of information (Rochmatika & Yana, 2022). The details of the indicators and their descriptions are presented in Table 1.

Table 1. Indicators of the Digital Literacy Questionnaire

No	Indicator	Description
1	Access to Digital Information	The ability to locate and obtain information from various digital sources effectively
2	Understanding Digital Information	The ability to understand the content, structure, and meaning of acquired information
3	Evaluation of Digital Information	The ability to assess the credibility, accuracy, and relevance of information
4	Evaluation of Digital Information	The ability to distinguish between valid and invalid information
5	Ethical Use of Information	The ability to use information in accordance with ethical principles and academic responsibility

The digital literacy questionnaire consisted of 20 statement items developed based on these indicators. The instrument employed a four-point Likert scale consisting of strongly disagree (1), disagree (2), agree (3), and strongly agree (4). The use of a four-point scale was intended to avoid neutral response tendencies and encourage respondents to provide more decisive answers. The validity test was conducted using the product-moment correlation technique, which indicated that all statement items had validity coefficients above 0.30 and were therefore considered valid. Reliability testing using Cronbach's Alpha coefficient yielded a value of 0.87, indicating that the instrument possessed a high level of internal consistency.

Critical Thinking Skills Test

The critical thinking skills test was developed based on the framework of critical thinking as a higher-order cognitive ability involving processes of analysis, evaluation, inference, and conclusion drawing (Sachdeva & Eggen, 2021; Sappaile et al., 2024). In this study, critical thinking ability was specifically focused on activities involving the evaluation of mathematical information, which conceptually represents the process of information evaluation within a digital context. The indicators of critical thinking ability measured in this study included analysis, evaluation, inference, and justification. The details of the indicators are presented in Table 2.

Table 2. Indicators of Critical Thinking Ability

No	Indicator	Description
1	Analysis	The ability to identify structures, concepts, and relationships within mathematical information
2	Evaluation	The ability to assess the correctness and accuracy of mathematical information or procedures
3	Inference	The ability to derive meaning or conclusions based on available information
4	Justification	The ability to provide logical reasons to support a decision or conclusion

The critical thinking skills instrument consisted of essay-type questions developed based on these indicators. Each test item was designed to measure more than one indicator, allowing students' critical thinking abilities to be identified comprehensively. The selection of essay questions was based on the consideration that this type of instrument is capable of exploring students' thinking processes more deeply, particularly in aspects related to analysis, evaluation, and conclusion drawing. Validity testing was conducted using the product-moment correlation technique, which showed that all test items had validity coefficients above 0.30 and were therefore considered valid. Reliability testing yielded a coefficient value of 0.82, indicating that the instrument possessed a high level of internal consistency.

Data Collection Procedure

The data collection procedure in this study was carried out systematically through several stages, including the preparation stage, implementation stage, and data processing stage. Each stage was designed to ensure that the data obtained were valid, reliable, and aligned with the objectives of the study. The stages of the data collection procedure are presented in Table 3.

Table 3. Stages of the Data Collection Procedure

Stage	Activities
Preparation	Developing research instruments in the form of a digital literacy questionnaire and a critical thinking skills test, conducting expert validation of the instruments, and carrying out a limited pilot test to examine instrument validity and reliability
Implementation	Determining research respondents based on the established criteria, distributing the digital literacy questionnaire online through Google Forms, and administering the critical thinking skills test in the form of essay questions under controlled conditions
Data Processing	Examining the completeness and consistency of the data, selecting data that met the established criteria, and inputting the data into statistical software for analysis

Data Analysis

Data analysis in this study was conducted quantitatively with the assistance of statistical software. The analysis aimed to identify the predictive relationship between digital literacy and the critical thinking ability of mathematics education students in evaluating digital mathematical information. Therefore, the findings of this study were not intended to explain a direct causal relationship between the variables. The analysis procedure began with descriptive statistical analysis to describe the characteristics of the data for each research variable. This analysis included the calculation of the mean, standard deviation, minimum value, and maximum value for both the digital literacy and critical thinking variables. In addition, score categorization was conducted based on predetermined intervals to determine the levels of students' digital literacy and critical thinking ability.

Prior to conducting regression analysis, the data were first examined through prerequisite tests, including tests of normality, linearity, and heteroscedasticity. The normality test was performed to ensure that the data were normally distributed, the linearity test was used to confirm that the relationship between variables was linear, and the heteroscedasticity test was conducted to examine the equality of residual variances within the regression model. After all assumptions had been satisfied, the analysis proceeded using simple linear regression to identify the predictive relationship between digital literacy and students' critical thinking ability. The regression model was expressed in the following equation:

$$Y = a + bX$$

where Y represents critical thinking ability, X represents digital literacy, a denotes the constant, and b represents the regression coefficient.

Hypothesis testing was conducted using the t-test to determine the significance of the influence of digital literacy on critical thinking ability. The decision-making criteria were based on the significance level with a 95% confidence interval ($\alpha = 0.05$). If the significance value was less than 0.05, digital literacy was considered to have a significant influence on students' critical thinking ability.

Research Findings

This section presents the findings related to the levels of digital literacy and critical thinking ability among mathematics education students, as well as the results of the analysis examining the influence of digital literacy on critical thinking ability in evaluating digital information.

Descriptive Analysis Results

Descriptive analysis was conducted to describe the characteristics of the data on students' digital literacy and critical thinking ability. The analysis included the minimum score, maximum score, mean, and standard deviation for each variable.

Table 4. Results of Descriptive Analysis

Variable	Minimum	Maximum	Mean	SD
Digital Literacy	62	91	76,38	6,94
Critical Thinking	54	88	71,12	7,85

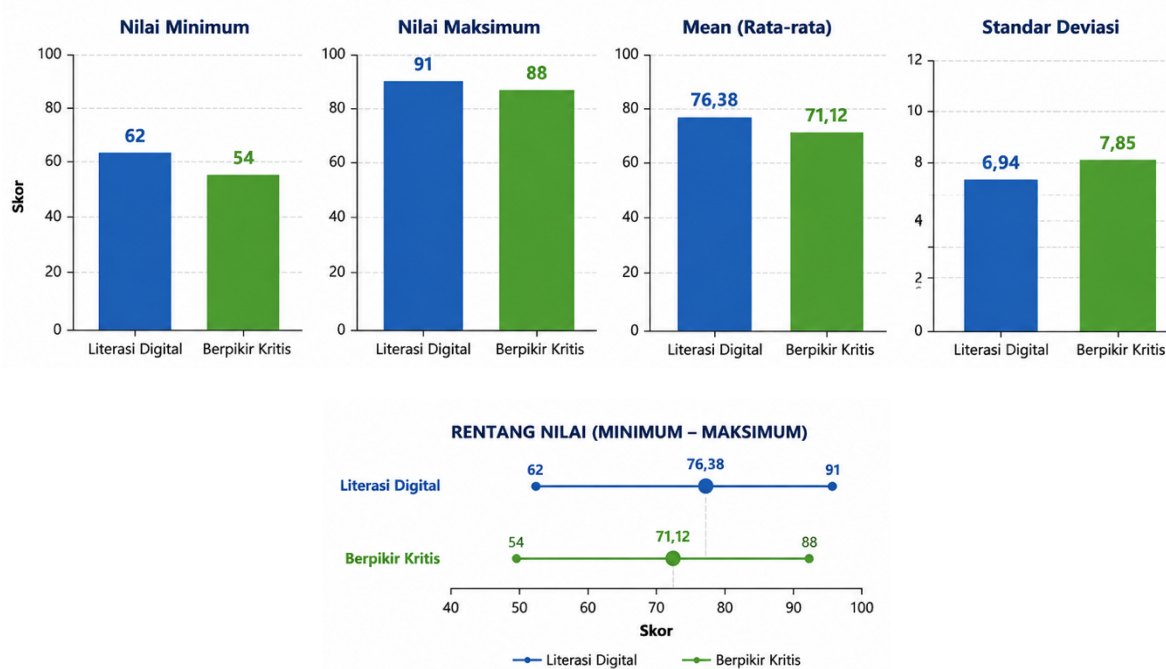


Figure 1. Diagram of Descriptive Data Analysis Results

Based on [Table 4](#) and [Figure 1](#), the mean score of students' digital literacy was 76.38, with a minimum score of 62 and a maximum score of 91. These findings indicate that, in general, students' digital literacy was categorized as high based on the predetermined score intervals. Furthermore, the standard deviation value of 6.94 indicates that the distribution of students' digital literacy abilities was relatively homogeneous or not highly varied. Nevertheless, several students still obtained relatively low scores, suggesting that the digital literacy abilities of some students had not yet developed optimally, particularly in aspects related to the evaluation and verification of digital information.

Meanwhile, students' critical thinking ability had a mean score of 71.12, with a minimum score of 54 and a maximum score of 88. These results indicate that students' critical thinking ability was categorized as moderate. The standard deviation value of 7.85, which was higher than that of the digital literacy variable, indicates greater variation in students' critical thinking abilities across individuals. This condition suggests that students' abilities in conducting analysis, evaluation, information verification, and conclusion drawing had not developed evenly.

Based on the comparison of the two variables presented in [Figure 1](#), the mean score of digital literacy was higher than that of critical thinking ability. This finding indicates that students were relatively familiar with accessing and utilizing digital technology; however, their ability to critically evaluate digital mathematical information had not yet developed optimally. Therefore, the ability to use technology has not been fully accompanied by the critical thinking ability required to assess the validity and credibility of digital information.

Prerequisite Test Results

Before conducting the regression analysis, prerequisite tests were first performed to ensure that the data met the assumptions required for regression analysis. The prerequisite tests included tests of normality, linearity, and heteroscedasticity.

Normality Test

The results of the normality test using the Kolmogorov–Smirnov test are presented in [Table 5](#).

Table 5. Results of the Normality Test

Variable	Statistic	Sig.
Digital Literacy	0.089	0.200
Critical Thinking	0.094	0.173

Based on [Table 5](#), the significance values for both variables were greater than 0.05. Therefore, it can be concluded that the data were normally distributed.

Linearity Test

The results of the linearity test between digital literacy and critical thinking ability are presented in [Table 6](#).

Table 6. Results of the Linearity Test

Relationship Between Variables	F	Sig.
Digital Literacy → Critical Thinking	1.87	0.082

Based on Table 6, the significance value was greater than 0.05, indicating that the relationship between digital literacy and critical thinking ability was linear.

Heteroscedasticity Test

The results of the heteroscedasticity test are presented in Table 7.

Table 7. Results of the Heteroscedasticity Test

Variable	Sig.
Digital Literacy	0.268

Based on Table 7, the significance value was greater than 0.05, indicating that there was no heteroscedasticity problem in the regression model.

Results of Simple Linear Regression Analysis

Simple linear regression analysis was conducted to examine the influence of digital literacy on the critical thinking ability of mathematics education students. The results of the regression analysis are presented in Table 8.

Table 8. Results of Simple Linear Regression Analysis

Variable	Regression Coefficient (b)	Constant (a)	t-value	Sig.
Digital Literacy	0.48	34.72	5.21	0.001

Based on Table 8, the regression coefficient value was 0.48, indicating that digital literacy had a positive influence on students' critical thinking ability. This means that every one-unit increase in digital literacy was followed by an increase of 0.48 in critical thinking ability. The constant value of 34.72 indicates that when digital literacy equals zero, the critical thinking ability score would be 34.72. Although this condition is rarely found in practice, the constant remains necessary in the regression model as the starting point for prediction.

The significance test results showed that the significance value was less than 0.001, which was smaller than 0.05. Therefore, it can be concluded that digital literacy had a significant influence on students' critical thinking ability. Thus, the research hypothesis stating that digital literacy influences students' critical thinking ability in evaluating digital information was accepted. In addition, the coefficient of determination (R^2) value obtained was 0.32, indicating that digital literacy contributed 32% to the variation in students' critical thinking ability. Meanwhile, the remaining 68% was influenced by other factors not examined in this study, such as cognitive ability, learning experiences, and instructional strategies.

Discussion

The findings of this study indicate that digital literacy has a positive and significant relationship with, and contributes to, the critical thinking ability of mathematics education students in evaluating digital information. The analysis results revealed a coefficient of determination value of $R^2 = 0.32$, indicating that digital literacy contributed 32% to the variation in students' critical thinking ability, while the remaining 68% was influenced by other factors beyond the scope of this study, such as mathematical reasoning ability, learning experiences, academic motivation, and instructional strategies.

Descriptively, the indicator of source credibility evaluation obtained the lowest achievement compared to other critical thinking indicators. The mean score for the source

credibility evaluation indicator was 68.4, which was lower than the indicators of information analysis (76.2), information verification (74.8), and conclusion drawing (72.5). These findings indicate that students still experienced difficulties distinguishing between valid and invalid digital mathematical information, particularly from digital sources presenting mathematical procedures or conceptual explanations without clear justification.

Based on these findings, it can be understood that digital literacy is not solely related to technical skills in accessing information, but is also associated with students' abilities to critically evaluate digital mathematical information. However, interpretations regarding possible causes of the low evaluation ability, such as the tendency of learning practices to emphasize procedural aspects, remain the authors' interpretations and were not directly examined in this study. Therefore, further investigation is required.

Theoretically, these findings can be explained through the framework of critical thinking as a cognitive process involving analysis, evaluation, inference, and justification. Within this perspective, critical thinking does not operate independently but strongly depends on the quality of the information being processed and the individual's ability to validate that information (Rochmatika & Yana, 2022; Rosalina et al., 2023). Digital literacy serves as an important bridge between information access and critical thinking processes because individuals with strong digital literacy tend to be more selective in accepting information, more reflective in understanding contexts, and more systematic in conducting evaluations (Luengo-Aravena et al., 2024; Mohommoud Zayid et al., 2026; Rany et al., 2025). This finding suggests that digital literacy functions not only as an instrumental skill but also as a cognitive competence contributing to the development of logical and structured reasoning.

Within the context of mathematics education, the relationship between digital literacy and critical thinking becomes increasingly relevant. Mathematics, as a discipline, demands conceptual precision, logical consistency, and strong evaluative abilities. Students are not only expected to solve problems but also to evaluate the correctness of solutions, identify errors, and provide justification for each step taken. When students interact with digital information, such as conceptual explanations or mathematical problem-solving procedures, digital literacy helps them assess whether the information is mathematically valid (Berta Dinata, 2021; Imjai et al., 2024). Therefore, digital literacy functions as a cognitive mechanism supporting critical thinking processes in understanding and evaluating mathematical information.

The findings of this study are also consistent with previous studies demonstrating a positive relationship between digital literacy and critical thinking ability (Mas Ramadhan et al., 2021; Rochmatika & Yana, 2022; Sappaile et al., 2025). Various studies have shown that individuals with high levels of digital literacy tend to possess stronger evaluative abilities, particularly in identifying credible and relevant information. However, most previous studies have positioned digital literacy within a general educational context without specifically relating it to particular domains of knowledge. This study contributes to the literature by demonstrating that such a relationship also applies within the context of mathematics education, which possesses distinctive characteristics regarding conceptual precision and logical reasoning. Nevertheless, the findings indicate that the contribution of digital literacy to critical thinking ability falls within the moderate category. This suggests that digital literacy is not the sole factor influencing students' critical thinking ability. Critical thinking is a multidimensional construct influenced by various factors, including basic cognitive abilities, learning experiences, motivation, and instructional strategies. Consequently, although digital literacy contributes significantly, the development of critical thinking skills still requires a more comprehensive educational approach (Rany et al., 2025; Rosalina et al., 2023; Rosyida & Bahtiar, 2024).

Another important finding is that the evaluative aspect, both in digital literacy and critical thinking, demonstrated relatively lower achievement compared to other indicators. This condition indicates that students' abilities to conduct in-depth evaluations of information have not yet developed optimally. Students generally appeared capable of accessing and understanding information, but they were not yet fully skilled in evaluating the accuracy and credibility of that information. This phenomenon reflects a gap between operational abilities and evaluative abilities within digital literacy. This condition may be explained by the tendency of learning practices that still focus more on procedural mastery than on the development of evaluative abilities. In many instructional practices, students are more frequently trained to obtain correct answers rather than to evaluate processes or assess the validity of information. As a consequence, evaluation skills as an essential component of critical thinking do not develop optimally. In this context, students' digital literacy has not been fully utilized to support deeper evaluative processes (Berta Dinata, 2021; Lim & Darvin, 2026; Wei et al., 2025).

The implications of these findings are highly important for the development of mathematics learning. Instructional strategies are needed that not only emphasize conceptual understanding but also encourage students to engage in evaluative activities. The integration of digital literacy into mathematics learning may serve as an effective approach, for example through activities involving information source analysis, evaluation of various mathematical solutions, and critical discussions regarding differences in conceptual representations (Dwiki Darmawan et al., 2025; Xiao et al., 2026; Young et al., 2026). Such approaches may help students develop critical thinking abilities more systematically. In addition, learning activities should be designed to encourage students to reflect on the information they receive. Reflection constitutes an essential component of critical thinking because it enables individuals to reconsider assumptions, arguments, and conclusions that have been formed. In this context, digital literacy can function as a means of accessing various perspectives, which can then be critically analyzed and evaluated by students.

The novelty of this study lies in the integration of digital literacy and critical thinking ability within the specific context of mathematics education, particularly in activities related to information evaluation. Unlike previous studies that tended to separate these two concepts, this study demonstrates that digital literacy can be positioned as a cognitive factor influencing critical thinking processes. Furthermore, this study emphasizes the importance of the evaluative aspect as a meeting point between digital literacy and critical thinking, which has received relatively limited attention in mathematics education research. Thus, this study contributes both theoretically and practically. Theoretically, it expands understanding regarding the relationship between digital literacy and critical thinking within a domain-specific context. Practically, it provides a foundation for developing instructional strategies capable of effectively integrating digital literacy and critical thinking.

Overall, the findings of this study confirm that digital literacy plays a strategic role in supporting the development of critical thinking ability among mathematics education students. However, to achieve optimal development, instructional approaches are required that focus not only on information access but also on students' abilities to evaluate and reflect critically on the information they encounter.

Conclusion

This study demonstrates that digital literacy has a positive relationship with and contributes to the critical thinking ability of mathematics education students in evaluating digital mathematical information. In this study, digital literacy was positioned as a predictor of

critical thinking ability, particularly in students' abilities to analyze information, evaluate source credibility, verify the accuracy of information, and draw conclusions regarding mathematical information obtained through digital media. The findings indicate that students with higher levels of digital literacy tend to possess more developed critical thinking abilities in understanding and evaluating mathematical information. Nevertheless, students' critical thinking ability, particularly in the aspect of evaluating digital information, has not yet developed optimally. This finding suggests that the ability to distinguish between valid and invalid mathematical information remains a challenge in mathematics learning.

Theoretically, this study contributes to the development of research on digital literacy as a cognitive factor associated with higher-order thinking skills within the context of mathematics education. These findings are particularly important for prospective mathematics teachers because the ability to critically evaluate digital information is essential to prevent the transmission of inaccurate information, incorrect solution procedures, or misconceptions in mathematics to students. However, this study has several limitations, including the use of a correlational design that cannot explain causal relationships comprehensively, the limitation of the research context to a single institution, and the use of self-report questionnaires to measure digital literacy, which may be influenced by respondents' subjectivity. Therefore, future studies are recommended to examine other variables such as instructional strategies, metacognition, and learning motivation, as well as to employ experimental designs and authentic performance-based instruments in order to obtain a more comprehensive understanding of the relationships among variables. In educational practice, lecturers are encouraged to integrate digital literacy into mathematics learning activities involving information searching, source evaluation, information analysis, and evidence-based argumentation so that students' critical thinking abilities can develop more optimally.

Conflict of Interest

The authors declare that there is no conflict of interest.

Auhor Contributions

All authors declare that the final version of this manuscript has been read and approved. S. conceptualized the research idea and collected the data. The second author (F.N.S) actively participated in the development of the theoretical framework, methodology, organization and analysis of the data, and discussion of the findings. The third author (M.) contributed to data interpretation, manuscript revision, and approval of the final version of the manuscript. The percentage contribution to the conceptualization, preparation, and revision of this manuscript was as follows: S.: 45%, F.N.S.: 35%, and M.: 20%.

Data Availability Statement

The authors declare that the data supporting the findings of this study will be made available by the corresponding author, [S.], upon reasonable request.




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