Jurnal Multidisiplin Ibrahimy
https://journal.ibrahimy.ac.id/index.php/Jummy
Volume 4, Issue 1, 40-53 e-ISSN: 3025-6607 | p-ISSN: 3025-6593
August 2026 DOI: 10.35316/jummy.v4i1.10113

The Influence of Statistical Literacy and Critical Thinking Skills on Student Learning Outcomes in Statistics Material

Ahmad Choirul Anam

Tadris matematika, Fakultas Tarbiyah, Universitas Ibrahimy Situbondo, Jawa Timur 68374, Indonesia

Received: 2026-06-29 Revised: 2026-07-30 Accepted: 2028-08-07 Published: 2026-08-10

Abstract

This study aims to determine the effect of statistical literacy and critical thinking skills on student learning outcomes in statistics material at SMAN Purwoharjo, Banyuwangi. The study used a quantitative correlational approach with 36 students of grade X in the even semester as subjects. Data were collected through statistical literacy tests, critical thinking skills assessment instruments, and statistical material learning outcome tests. Data analysis was conducted using multiple linear regression. The results showed that statistical literacy and critical thinking skills had a positive and significant effect on student learning outcomes, both partially and simultaneously. The coefficient of determination value of R^2 was 0,72 indicates that 72% of the variation in student learning outcomes can be explained by statistical literacy and critical thinking skills. Partially, critical thinking skills have a greater contribution, namely β = 0,471, compared to statistical literacy with β = 0,401. These findings indicate that statistical learning outcomes are not only influenced by calculation skills, but also by the ability to understand data, interpret statistical information, evaluate arguments, and draw logical conclusions.

Keywords Critical Thinking Skills; Learning Outcomes; Statistics; Statistical Literacy.

Corresponding Author
Ahmad Choirul Anam
Universitas Ibrahimy Situbondo, Indonesia; choirulanam@ibrahimy.ac.id

INTRODUCTION

The development of science, technology, and information in the 21st century has made data present in almost every aspect of life. Students are confronted not only with numbers in textbooks but also with graphs, tables, percentages, surveys, infographics, poll results, and statistical reports disseminated through social media, online news, government documents, and various digital platforms. In this context, mathematics learning, particularly statistics, is not solely focused on the ability to calculate the mean, median, mode, or create diagrams. Students need to be equipped with the skills to read data, interpret information, evaluate the reasonableness of conclusions, and use data as a basis for decision-making.

The urgency of strengthening these skills aligns with Phase E Mathematics Learning Outcomes, which require students to be able to represent and interpret data, understand measures of distribution, read various forms of diagrams, explain relationships between data, and evaluate statistical reports in the media. This means that statistics learning in high school emphasizes not only calculation procedures but also the ability to understand, assess, and

critically use data-based information. However, the state of numeracy and higher-order thinking skills of Indonesian students remains a concern. The results of the 2022 PISA (PISA) show that Indonesian students' mathematics achievement and higher-order thinking skills are still below the OECD average, making strengthening reasoning, data-based, and problem-solving-based learning an urgent need.

Statistical literacy is a crucial competency because it directly relates to students' ability to understand data-based phenomena. Statistical literacy encompasses the ability to read, understand, interpret, present, process, evaluate, and communicate statistical information. Several recent studies have shown that students and university students still face various challenges in their statistical literacy skills, particularly in understanding basic concepts, interpreting data, constructing data-based arguments, and drawing appropriate conclusions (Azis & Dahlan, 2024; Apino et al., 2024; Trisnawati & Mahmudi, 2024; Hasanah et al., 2024). These findings suggest that statistical literacy challenges extend beyond calculation skills to understanding the meaning of data in real-world contexts.

In addition to statistical literacy, critical thinking skills also play a crucial role in statistics learning. Critical thinking helps students assess the accuracy of information, distinguish between relevant and irrelevant data, evaluate problem-solving procedures, and draw conclusions based on logical reasoning. In statistics learning, students need to understand more than simply answering the question "what is the average of the data?" They also need to understand "what the average means," "is the data sufficiently representative," "are the conclusions drawn from the graphs correct," and "is the statistical information reliable." Therefore, critical thinking skills are crucial for students to not only process data but also evaluate and use it responsibly.

Several studies in the past three years have emphasized the importance of learning that develops statistical literacy and critical thinking. Friedrich et al. (2024) and Schreiter et al. (2024) emphasize that statistical and data literacy learning will be more effective if it uses real-world data, authentic problems, and meaningful learning practices. Other studies have shown that Realistic Mathematics Education, guided discovery learning, contextual learning, and open-ended approaches can help improve students' statistical literacy and critical thinking skills (Hakim & Setyaningrum, 2024; Hariyanti et al., 2025; Fitriyah et al., 2024; Putri et al., 2025). In general, these studies demonstrate that statistics learning needs to provide space for students to read data, reason, discuss, evaluate information, and draw conclusions.

However, there are still research gaps that need to be clarified. Most previous studies tend to discuss statistical literacy and critical thinking skills separately. Research on statistical literacy generally focuses on students' ability to read, interpret, or present data, while research on critical thinking is more directed at reasoning skills, problem-solving, or the effectiveness of specific learning models. However, in statistics learning, these two skills do not function separately. Students who read data still need critical thinking skills to assess the meaning and reasonableness of information, while students who think critically require a foundation in statistical literacy so that their conclusions are truly data-based. Therefore, research is still needed that examines the influence of statistical literacy and critical thinking skills simultaneously on student learning outcomes, rather than simply viewing them as standalone skills.

Based on this gap, this study is not merely a replication of previous research in a local context, but seeks to provide a more comprehensive picture of the cognitive factors that support student success in learning statistics. SMAN Purwoharjo was chosen as the research context because statistics learning in grade 10 provides a relevant space to examine how the ability to understand data and critical thinking skills relate to student learning outcomes. In statistics material, students are required to read data, find patterns, choose appropriate procedures, compare information, evaluate conclusions, and solve context-based problems. This process demonstrates that statistics learning outcomes cannot be explained solely through mastery of formulas, but need to be viewed from the integration of statistical literacy and critical thinking skills.

Thus, this study aims to determine the effect of statistical literacy and critical thinking skills on student learning outcomes in statistics at SMAN Purwoharjo. It also aims to determine whether these two variables together significantly influence learning outcomes and to determine which variables contribute most to student success in understanding statistics.

RESEARCH METHODS

This study used a quantitative approach with a correlational approach. This approach was chosen because the study aimed to examine the influence of two independent variables statistical literacy and critical thinking skills on one dependent variable, student learning outcomes in statistics. A correlational design was used to determine the relationship and magnitude of influence between variables through multiple linear regression analysis.

The research was conducted at SMAN Purwoharjo, Banyuwangi, on 10th-grade students in the even semester. The research subjects were 36 students. Because the number of subjects was relatively limited and all students in the class were respondents, the sampling technique used was saturated sampling. With this technique, all members of the accessible population were included in the research sample.

The variables in this study consist of three variables. The first independent variable is statistical literacy skills (X_1), namely students' ability to read, understand, interpret, analyze, evaluate, and communicate statistical information. The second independent variable is critical thinking skills (X_2), namely students' ability to identify problems, provide reasons, evaluate information, make inferences, and draw logical conclusions. The dependent variable is statistics learning outcomes (Y), namely students' achievements after participating in statistics learning materials as measured by learning outcome tests.

The research instruments consist of three types. First, a statistical literacy test consisting of descriptive and data context questions that measures the ability to read tables/graphs, interpret measures of central tendency and dispersion, compare data, and summarize statistical information. Second, a critical thinking skills instrument consisting of an assessment rubric referring to indicators of interpretation, analysis, evaluation, inference, and explanation of reasons. Third, a statistics learning outcome test consisting of multiple-choice and descriptive questions that measures conceptual understanding, application of procedures, data analysis, and statistical problem-solving.

Before use, the instrument is tested for content validity through expert assessment by mathematics teachers or mathematics education lecturers. Empirical validity can be tested using product-moment correlation, while instrument reliability can be tested using Cronbach's Alpha. The instrument is declared reliable if the Alpha value is $\geq 0{,}70$. The research data was analyzed using descriptive and inferential statistics with the help of SPSS.

Table 1. Result Analitics of Research Instrument

Instrument	Number of Items	Valid Items	Invalid Item	Range r Count	Cronbach Alpha	Conclusion
Statistical Literacy Test	8	8	0	0.421 – 0.781	0.842	Valid and Reliable
Critical Thinking Skills	5	5	0	0.456 – 0.804	0.861	Valid and Reliable
Statistics Learning Outcome Test	20	20	0	0.398 – 0.763	0.887	Valid and Reliable

Testing criteria:

- r count > r table ($0{,}344$ at $N = 36, \alpha = 0{,}05$) → valid
- Cronbach Alpha $> 0{,}70$ → reliable

Based on the instrument test results, all items in the statistical literacy, critical thinking skills, and statistical learning outcomes tests had correlation values greater than the table's r value, thus all items were declared valid. Furthermore, the Cronbach's Alpha values for all instruments were above 0.70, indicating that the instruments had a good level of internal consistency and could be used as research data collection tools.

The stages of data analysis include: (1) descriptive analysis to determine the average value, standard deviation, minimum value, and maximum; (2) analysis prerequisite tests consisting of normality, linearity, multicollinearity, and heteroscedasticity tests; (3) multiple linear regression analysis to test the influence of statistical literacy and critical thinking skills on learning outcomes; (4) t-test to determine the partial influence of each independent variable; (5) F-test to determine the simultaneous influence of both independent variables; and (6) coefficient of determination R^2 to determine the magnitude of the contribution of both independent variables to learning outcomes.

Table 2. Regression Assumption Test Results Summary Table

No.	Test Type	Indicator	Results	Criteria	Conclusion
1	Normality	Kolmogorov-Smirnov	Sig. = 0.200	Sig. > 0.05	Normally distributed data
2	Linearity	$X_1 \rightarrow Y$ (Deviation from Linearity)	Sig. = 0.384	Sig. > 0.05	Linear relationship
		$X_2 \rightarrow Y$ (Deviation from Linearity)	Sig. = 0.536	Sig. > 0.05	Linear relationship
3	Multicollinearity	Tolerance X_1	0.676	> 0.10	There is no multicollinearity
		VIF X_1	1,479	< 10	There is no multicollinearity
		Tolerance X_2	0.676	> 0.10	There is no multicollinearity
		VIF X_2	1,479	< 10	There is no multicollinearity
4	Heteroscedasticity	Glejser X_1 Test	Sig. = 0.341	Sig. > 0.05	There is no heteroscedasticity
		Glejser X_2 Test	Sig. = 0.287	Sig. > 0.05	There is no heteroscedasticity

Based on the test results in Table 2, the normality test using One-Sample Kolmogorov-Smirnov shows a significance value of 0.200 (> 0.05), so that the residual data is normally

distributed. The linearity test using Deviation from Linearity produces a significance value of 0.384 for the relationship between statistical literacy and learning outcomes and 0.536 for the relationship between critical thinking skills and learning outcomes, both of which are greater than 0.05, indicating a linear relationship. Furthermore, the multicollinearity test shows that both independent variables have a Tolerance value of 0.676 (> 0.10) and a Variance Inflation Factor (VIF) of 1.479 (< 10), so there are no symptoms of multicollinearity. The results of the heteroscedasticity test using the Glejser Test show a significance value of 0.341 for the statistical literacy variable and 0.287 for critical thinking skills, both of which are greater than 0.05, so there are no symptoms of heteroscedasticity. Thus, all regression assumptions have been met so that the multiple linear regression model is considered suitable for use to test the influence of statistical literacy and critical thinking skills on student learning outcomes in statistics material.

Overall, the results of the regression assumption test indicate that all requirements for multiple linear regression analysis have been met. The residual data are normally distributed, the relationship between the independent and dependent variables is linear, there is no high correlation between the independent variables (multicollinearity), and no symptoms of heteroscedasticity are found. With all these assumptions met, the multiple linear regression model used in this study is considered suitable for testing the effect of statistical literacy and critical thinking skills on student learning outcomes in statistics material. Therefore, the regression analysis conducted can provide valid parameter estimates, so that the results of the hypothesis testing can be trusted and used as a basis for drawing research conclusions.

The regression model used is:

$$Y = a + b_1X_1 + b_2X_2 + e$$

Information:
Y = statistics learning outcomes
a = constant
b_1 = statistical literacy regression coefficient
b_2 = regression coefficient $critical\ thinking\ skills$
X_1 = statistical literacy
X_2 = *critical thinking skills*
e = error

The research hypothesis is formulated as follows. H_1: statistical literacy has a positive and significant effect on statistics learning outcomes. H_2: Critical thinking skills have a positive and significant effect on statistics learning outcomes. H_3: Statistical literacy and critical

thinking skills simultaneously have a positive and significant effect on statistics learning outcomes.

RESULTS AND DISCUSSION

This section presents research results and a discussion regarding the influence of statistical literacy and critical thinking skills on student learning outcomes in statistics at SMAN Purwoharjo, Banyuwangi. The description of the research results is structured to answer the research objective, namely to determine whether students with good statistical literacy skills, such as being able to read, understand, interpret, analyze, and evaluate data, tend to achieve higher statistics learning outcomes. In addition, this section also explains whether students' critical thinking skills, which include the ability to analyze problems, provide logical reasons, evaluate information, and draw conclusions, influence their learning achievement. More broadly, the results of this study are also used to determine whether statistical literacy and critical thinking skills together have a significant influence on student learning outcomes, as well as to determine which variables have a greater contribution in supporting students' success in understanding statistics material.

The research data were obtained from 33 even-semester tenth-grade students at SMAN Purwoharjo. Three types of data were analyzed, including statistical literacy scores, critical thinking skills scores, and student learning outcomes scores on statistics material. Data analysis was conducted using multiple linear regression with the help of SPSS because this study involved two independent variables, namely statistical literacy and critical thinking skills, and one dependent variable, namely statistics learning outcomes. Before conducting the regression analysis, the data were first tested through prerequisite tests, including normality, linearity, multicollinearity, and heteroscedasticity tests. The results of the prerequisite tests showed that the data met the requirements for analysis using multiple linear regression.

Table 3. Descriptive Statistics of Research Variables

Variables	N Statistics	Minimum Statistics	Maximum Statistics	Mean	Standard Deviation
Statistical Literacy(X_1)	36	70	90	80.77	5.5803
Critical Thinking Skills(X_2)	36	74	92	83.17	5.0925
Statistics Learning Outcomes(Y)	36	75	94	84.69	5.1198

Based on Table 3, the average statistical literacy ability of students was 80.77, the average critical thinking skills was 83.17, and the average statistical learning outcome was 84.69. These values indicate that students generally have a fairly good ability to understand statistical material. However, the range of minimum and maximum scores for each variable indicates differences in ability between students. Some students already have good abilities in reading data, understanding statistical information, interpreting tables or graphs, and drawing conclusions, while others still need reinforcement in understanding the data more deeply. This condition is in line with the view that statistical literacy includes the ability to read, understand, interpret, represent, process, evaluate, and communicate statistical information critically (Azis & Dahlan, 2024).

The descriptive statistics also show that students' critical thinking skills are in the good category. This indicates that most students were able to analyze problems, provide logical reasoning, evaluate information, and draw conclusions based on available data. In statistics learning, critical thinking skills are crucial because students are not only required to calculate measures of central tendency or data dispersion, but also to understand the meaning of the data, assess the reasonableness of the information, and draw conclusions based on evidence. Critical thinking in mathematics learning relates to the ability to analyze, evaluate, and draw logical conclusions when students face complex or contextual mathematical problems (Putri et al., 2025).

Table 4. Multiple Linear Regression Summary Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.852	0.726	0.709	4.71

Based on Table 4, the R value is 0.852. This value indicates a strong relationship between statistical literacy and critical thinking skills with student learning outcomes in statistics. The R Square value of 0.726 indicates that 72% of the variation in student learning outcomes can be explained by statistical literacy and critical thinking skills. The remaining 28% is influenced by other factors outside this study, such as learning motivation, interest in mathematics, study habits, learning strategies, environmental support, the quality of teaching materials, and the use of learning media. Thus, statistical learning outcomes are not only determined by calculation skills but also influenced by students' abilities to understand, interpret, evaluate, and use data

logically. This is in line with the view that learning statistical literacy and data literacy at the school level needs to be linked to authentic problems, real-world contexts, and problem-solving processes so that students are able to use data to make meaningful decisions (Friedrich et al., 2024).

Table 5. F Test Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1856.42	2	928.21	41.83	0.000
Residual	732.58	33	22.20		
Total	2589.00	35			

The F-test results in Table 5 show an F-value of 41.83 with a significance value of 0.000. Because the significance value is less than 0.05, it can be concluded that statistical literacy and critical thinking skills together have a positive and significant effect on student learning outcomes in statistics material. This fact indicates that student success in understanding statistics material is not determined solely by one ability, but by the integration of data comprehension and critical thinking skills. Theoretically, statistical literacy helps students read, understand, and interpret data-based information, while critical thinking skills help students evaluate information, provide logical reasoning, and draw appropriate conclusions. Both are important skills in statistics learning because students need to understand data while assessing the meaning and accuracy of the information obtained from that data (Schreiter et al., 2024).

Table 6. Regression Coefficient Test Results

Variabel	Unstandardized *B*	Std. Error	Standardized Beta	t	Sig.
Constant	13.842	5.982	-	2.313	0.027
Statistical Literacy	0.386	0.104	0.401	3.712	0.001
Critical Thingking Skills	0.468	0.109	0.471	4.294	0.000

Based on Table 6, the following regression equation is obtained.

$$Y = 13.842 + 0.386X_1 + 0.468X_2$$

The equation shows that every increase in statistical literacy skills will be followed by an increase in student learning outcomes of 0.401, assuming the critical thinking skills variable

remains constant. Meanwhile, every increase in critical thinking skills will be followed by an increase in student learning outcomes of 0.471, assuming the statistical literacy variable remains constant. The statistical literacy significance value of 0.001 is smaller than 0.05, so statistical literacy has a positive and significant effect on student learning outcomes. The critical thinking skills significance value of 0.000 is also smaller than 0.05, so critical thinking skills have a positive and significant effect on student learning outcomes.

The results of the study indicate that statistical literacy has a positive and significant effect on student learning outcomes in statistics. This fact is demonstrated by the beta coefficient value of statistical literacy of 0.401 with a significance value of 0.001. This means that students who have better abilities in reading, understanding, interpreting, analyzing, and evaluating data tend to achieve higher statistics learning outcomes. In theory, statistical literacy is an important skill that enables students to understand statistical information in various presentation forms, such as tables, diagrams, graphs, and contextual data (Azis & Dahlan, 2024). In statistics learning, students with good statistical literacy will more easily determine important information from data, understand measures of central tendency and dispersion, compare groups of data, and draw conclusions based on available information. Based on these facts and theories, the researchers argue that statistical literacy needs to be developed through learning that presents real-world data, such as student grades, attendance data, school environment data, simple survey results, or data on social phenomena close to students' lives. Through these activities, students not only memorize formulas but also understand the function of statistics in reading and explaining real-world problems.

In addition to statistical literacy, research results also show that critical thinking skills have a positive and significant impact on student learning outcomes in statistics. This fact is evidenced by a beta coefficient value of 0.471 and a significance value of 0.000. This beta value indicates that critical thinking skills have a greater contribution than statistical literacy. This means that students who have better critical thinking skills tend to achieve higher statistics learning outcomes. In theory, critical thinking in mathematics learning is related to the ability to understand problems, analyze information, evaluate the truth of a statement, provide logical reasons, and draw conclusions based on evidence (Putri et al., 2025). In the context of statistics, critical thinking skills are essential because many statistics problems cannot be solved simply by formulas, but require an understanding of the problem context, the accuracy of selecting relevant data, the ability to check the reasonableness of answers, and the skill of drawing conclusions. Based on these facts and theories, researchers argue that statistics learning should

not only be provided in the form of routine practice questions, but also developed through open-ended questions, group discussions, case studies, and problem-solving activities. An open learning approach can help students develop critical thinking skills because students are given the opportunity to develop various strategies, provide reasons, and be accountable for their answers (Fitriyah et al., 2024).

Simultaneously, statistical literacy and critical thinking skills have been shown to have a positive and significant impact on student learning outcomes in statistics. This fact is demonstrated by the R Square value of 0.720, which means that 72% of the variation in student learning outcomes can be explained by these two variables, while the remaining 28% is influenced by other factors outside the study. Furthermore, the F test results show a significance value of 0.000, which is smaller than 0.05, so it can be concluded that statistical literacy and critical thinking skills together have a significant influence on statistics learning outcomes. In theory, these two abilities are interrelated and mutually reinforcing. Statistical literacy helps students understand and process data-based information, while critical thinking skills help students assess, evaluate, and use that information to draw logical conclusions. Learning statistics and data literacy in schools will be more meaningful if it involves real data, authentic problems, and learning strategies that encourage students to interpret and evaluate information (Friedrich et al., 2024; Schreiter et al., 2024). Based on these facts and theories, researchers argue that effective statistics learning requires integrating data literacy and critical thinking activities into a single learning process. Teachers can design activities that involve simple data collection, presentation in tables or diagrams, analysis of the results, discussion of interpretations, and presentation of conclusions. Through these activities, students not only achieve better learning outcomes but also develop the ability to use statistics as a tool to understand real-world problems rationally and responsibly.

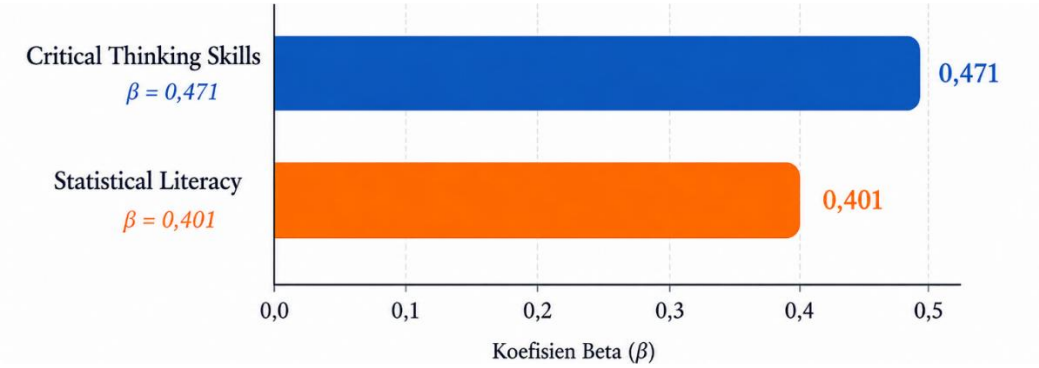

Figure 1. Comparison of Variable Contributions to Learning Outcomes

In Figure 1 The results indicate that critical thinking skills contribute more to student learning outcomes than statistical literacy. Nevertheless, both variables still have a positive and significant effect on learning outcomes. Therefore, students with strong statistical literacy skills will more easily understand data-based information, while students with strong critical thinking skills will be better able to analyze problems, evaluate information, and draw logical conclusions. The combination of these two skills is a crucial factor in improving student learning success in statistics.

Overall, the results of this study answer the research objective: statistical literacy and critical thinking skills influence student learning outcomes in statistics. Statistical literacy helps students read, understand, interpret, and evaluate data, while critical thinking skills help students analyze problems, provide logical reasoning, evaluate information, and draw conclusions. These two skills complement each other in supporting student learning outcomes. Therefore, improving statistics learning outcomes needs to be done through learning that not only emphasizes mastery of formulas but also trains students to read data, interpret information, think logically, convey reasons, and draw conclusions based on evidence.

CONCLUSION AND SUGGESTIONS

Based on the research results, it can be concluded that statistical literacy and critical thinking skills play a significant role in improving student learning outcomes in statistics. Statistical literacy helps students understand, interpret, and evaluate data-based information, while critical thinking skills support the ability to analyze problems, provide logical reasoning, and draw conclusions based on evidence. These findings indicate that successful statistics learning is determined not only by mastery of concepts and calculation procedures, but also by the ability to understand data and think critically in solving contextual problems. This research contributes to the development of statistical learning studies by demonstrating that statistical literacy and critical thinking skills are two complementary competencies in shaping students' statistical understanding. Unlike some previous studies that examined the two variables separately, this study demonstrates that both simultaneously contribute to learning outcomes. These findings reinforce the perspective that statistics learning should be directed at developing data-based reasoning through analysis, interpretation, evaluation, and decision-making activities, so that students are not only able to perform calculations but also to use statistical information rationally in their daily lives.

However, this study still has several limitations. The sample size, which only involved 36 students from a single school, means the results cannot be widely generalized. Furthermore, the correlational research design can only explain the relationship between variables without demonstrating a direct cause-and-effect relationship. This study also failed to account for other factors that could potentially influence learning outcomes, such as learning motivation, initial numeracy skills, learning strategies, or the use of technology in the learning process.

Based on these limitations, further research is recommended to involve a larger sample size and be conducted across multiple schools to enhance generalizability. Structural Equation Modeling (SEM) can also be used to test mediation or moderation models, for example by using critical thinking skills as a mediator or learning motivation and learning strategies as moderators. For teachers, the results of this study can serve as a basis for designing more contextual statistics instruction through the use of authentic data, problem-based learning, data investigation, and argumentative discussions, thereby optimally developing students' statistical literacy and critical thinking skills.

REFERENCES

Anam, A. C. (2025). The Complexity of High School Students' Semiotic Graphics in Solving Statistical Problems. Jurnal Multidisiplin Ibrahimy, 3(1), 102–116. https://doi.org/10.35316/jummy.v3i1.7882

Apino, E., Retnawati, H., Purbani, W., & Hidayati, K. (2024). The statistical literacy of mathematics education students: An investigation on understanding the margin of error. TEM Journal, 13(1), 293–302. DOI: 10.18421/TEM131-31

Asari, A., Zulkarnaini, Z., Hartatik, H., Anam, A. C., Suparto, S., Litamahuputty, J. V., ... & Sukwika, T. (2023). Pengantar statistika. Sumatera Barat: PT Mafy Media Literasi Indonesia

Azis, A., & Dahlan, J. A. (2024). Statistical literacy level of mathematics education students: Challenges and recommendations for competency improvement. Alifmatika: Jurnal Pendidikan dan Pembelajaran Matematika, 6(2), 263–278. DOI: 10.35316/alifmatika.2024.v6i2.263-278

Fitriyah, Y., Wahyudin, Suhendra, Nurhayati, H., & Febriyanti, T. S. (2024). Open-ended approach for critical thinking skills in mathematics education: A meta-analysis. Edumatsains: Jurnal Pendidikan Matematika dan Sains, 9(1), 156–174. DOI: 10.33541/edumatsains.v9i1.5975

Friedrich, A., Schreiter, S., Fuhr, H., Malone, S., Brünken, R., Kuhn, J., & Vogel, M. (2024). What shapes statistical and data literacy research in K-12 STEM education? A systematic review of metrics and instructional strategies. International Journal of STEM Education, 11, 58. DOI: 10.1186/s40594-024-00517-z

Habibie, Z. R., Kartono, Wardono, & Kharisudin, I. (2023). Analysis of student statistical literacy using test questions integrated with Indonesian education issues as a form of

contextual approach. Polyhedron International Journal in Mathematics Education, 1(2). DOI: 10.59965/pijme.v1i2.48

Hakim, T. A., & Setyaningrum, W. (2024). Realistic mathematics education combined with guided discovery for improving middle school students' statistical literacy. Journal of Honai Math, 7(2), 233–246. DOI: 10.30862/jhm.v7i2.564

Hariyanti, F., Budayasa, I. K., & Setianingsih, R. (2025). Design and evaluation of a guided discovery learning model to enhance junior secondary students' statistical literacy. Journal of Education Culture and Society, 16(2), 685–708. DOI: 10.15503/jecs2025.3.685.708

Hasanah, U., Putrawangsa, S., Setiawati, F. A., & Purwanta, E. (2024). Statistical literacy in primary education: An analysis of Indonesian fifth-graders' data interpretation and analysis skills. Journal on Mathematics Education, 15(4), 1335–1356. DOI: 10.22342/jme.v15i4.pp1335-1356

Kementerian Pendidikan Dasar dan Menengah. (2024). Capaian pembelajaran matematika Fase E. Kemendikdasmen.

Ningsih, P. O. (2024). Strategic factors that influence critical thinking ability in mathematics learning in elementary schools. Formatif: Jurnal Ilmiah Pendidikan MIPA.

OECD. (2023). PISA 2022 results: Factsheets—Indonesia. OECD Publishing.

OECD. (2024). PISA 2022 results volume III factsheets: Indonesia. OECD Publishing.

Putri, A., Nusantara, T., Purwanto, & As'ari, A. R. (2025). The contribution of critical thinking skills in rich mathematical problem completion: Insights from pre-service mathematics teachers. Eurasia Journal of Mathematics, Science and Technology Education, 21(2), em2581. DOI: 10.29333/ejmste/15931

Sabbag, A., Zieffler, A., & Ng, C. (2025). Can we distinguish statistical literacy and statistical reasoning? Statistics Education Research Journal, 24(1). DOI: 10.52041/serj.v24i1.587

Sari, R. N., & Juandi, D. (2023). Improving student's critical thinking skills in mathematics education: A systematic literature review. Jurnal Cendekia: Jurnal Pendidikan Matematika, 7(1). DOI: 10.31004/cendekia.v7i1.2091

Schreiter, S., Friedrich, A., Fuhr, H., Malone, S., Brünken, R., Kuhn, J., & Vogel, M. (2024). Teaching for statistical and data literacy in K-12 STEM education: A systematic review on teacher variables, teacher education, and impacts on classroom practice. ZDM—Mathematics Education, 56, 31–45. DOI: 10.1007/s11858-023-01531-1

Trisnawati, R. A., & Mahmudi, A. (2024). Assessing data literacy competencies in mathematics among junior high school students in Yogyakarta City. Al-Ishlah: Jurnal Pendidikan, 16(3). DOI: 10.35445/alishlah.v16i3.5072

Utari, R. S., Zulkardi, Putri, R. I. I., & Susanti, E. (2023). Development of statistical literacy questions for prospective mathematics teachers. Jurnal Inovasi Matematika, 5(1). DOI: 10.35438/inomatika.v5i1.367

Wijayanti, P. S., & Juandi, D. (2024). Student statistical literacy as an initial study for Sekolah Siaga Kependudukan in Indonesia: A systematic literature review. Jurnal Paedagogy, 11(2). DOI: 10.33394/jp.v11i2.9217