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Effect of Mathematical Literacy on Students' Learning Outcomes In The Subject of Systems of Linear Equations With Two Variables

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Abstract: This study aims to determine the effect of mathematical literacy on students' learning outcomes in the topic of Systems of Linear Equations in Two Variables (SPLDV). This research employed a quantitative approach using correlational and simple linear regression methods. The sample consisted of 26 eighth-grade students of the Unggul class at SMPN 1 Linggo Sari Baganti. Mathematical literacy data were collected through questionnaires, while learning outcomes were obtained from SPLDV tests. The results showed a moderate positive correlation between mathematical literacy and learning outcomes with a correlation coefficient of 0.52. Regression analysis indicated a significance value of $0.007 < 0.05$, meaning that mathematical literacy has a significant effect on students' learning outcomes. Therefore, higher mathematical literacy contributes to better learning outcomes.

Keywords: Literasi Matematika, Hasil Belajar, SPLDV

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INTRODUCTION

Mathematics learning holds a strategic position in education because it shapes logical, analytical, and systematic ways of thinking that students need in order to understand problems and make reason-based decisions. Therefore, mathematics should not be narrowly reduced to a collection of formulas and mechanistic procedures; rather, it should be understood as a process of reasoning that helps students structure information, identify patterns, and solve real-life problems in a measurable way (Nurhalin & Effendi, 2022). Consequently, the orientation of mathematics instruction needs to shift from the dominance of procedural drills toward the strengthening of higher-order thinking skills that require modeling, reasoning, and reflection on solutions. One construct that directly represents these demands is mathematical literacy, because mathematical literacy positions mathematics as a tool for thinking in order to connect concepts with contexts and to assess the reasonableness of results.

Mathematical literacy is understood as an individual's ability to formulate situations into mathematical models, use mathematical concepts and procedures appropriately, and interpret calculation results meaningfully in various contexts (Lindawati, 2018; Rahmawati, 2018). This definition emphasizes that mathematical literacy is not merely about "being able to calculate," but also includes the ability to select relevant information, represent problems, determine solution strategies, and interpret and evaluate answers. Within the international framework, mathematical literacy has become a major concern because it is measured comparatively through assessments such as the Programme for International Student Assessment (PISA). PISA assesses the extent to which students can use mathematics to solve real-world problems, so its results are often used as indicators of learning quality and of the younger generation's readiness to face the challenges of the twenty-first century (OECD, 2019, 2023). Thus, efforts to improve mathematics learning outcomes should ideally not focus solely on achieving scores on procedure-based examinations, but also on strengthening mathematical literacy as a core competency.

PISA findings show that Indonesian students' mathematical literacy skills remain relatively low, indicating problems in understanding contexts, constructing models, and interpreting answers rationally (OECD, 2019). This low achievement should not be viewed merely as a weakness of the students, but rather as a signal that classroom instructional design needs to place greater emphasis on meaningful learning, contextual problem solving, and the strengthening of reasoning processes. If instruction places excessive emphasis on routine exercises and uniform question patterns, students tend to rely on memorized steps and thus become fragile when confronted with word problems, contextual data, or situations that require reasoning across

representations. In this context, mathematical literacy becomes crucial because it connects conceptual mastery with the ability to apply mathematics to varied situations.

One topic that clearly demands mastery of mathematical literacy is Systems of Linear Equations in Two Variables (SPLDV). The SPLDV topic does not stop at algebraic solution procedures, but requires students to understand information, identify variables, formulate equation models from contexts, choose a solution method (elimination, substitution, or graphing), and then reinterpret the solution according to the context of the problem. In word problems, students must carry out the process from context to model and from model back to context, which is the essence of mathematical literacy (OECD, 2019; Rahmawati, 2018). However, studies show that students still experience difficulties in SPLDV, especially in story-based and contextual problems, such as misunderstanding information, incorrectly defining variables, and inaccurately constructing equation models (Agustini & Pujiastuti, 2020; Fimillatika & Haerudin, 2023; Pradini et al., 2020). These difficulties may result in incorrect answers even when students have memorized the method, because the failure occurs at the stages of formulating and interpreting, not merely in calculation.

Difficulties in SPLDV directly affect learning outcomes. Learning outcomes are indicators of instructional success that are influenced by internal and external factors. Among internal factors, mathematical literacy is considered relevant because it determines the quality of problem comprehension, the appropriateness of strategy selection, and the accuracy of answer interpretation (Lindawati, 2018; Rahmawati, 2018). A number of studies show a significant relationship and influence between mathematical literacy and mathematics learning outcomes, so that improvements in literacy tend to go hand in hand with better academic achievement (Harefa et al., 2023; Suryaprani et al., 2017). In the context of SPLDV, this relationship becomes even more important because SPLDV is often assessed through word problems and simple modeling; this means that students with better mathematical literacy have a greater opportunity to achieve optimal learning outcomes because they are able to process contexts into models correctly and assess the reasonableness of solutions.

Even so, the available research still shows unevenness in focus and depth of analysis. Many SPLDV studies emphasize the mapping of difficulties or the analysis of students' errors in story problems, so that the research output often takes the form of lists of error types and problematic points faced by students (Pradini et al., 2020; Rodiana et al., 2024). This approach is important for diagnosis, but it does not always answer how large the contribution of mathematical literacy is to SPLDV learning outcomes when tested empirically in a particular classroom or school context with instruments aligned to the material and instructional objectives. As a result, the contributive relationship (or influence) of mathematical literacy on SPLDV achievement in local contexts still requires more focused investigation, especially to ensure that interventions aimed at improving learning outcomes do not only focus on procedural practice, but also target the literacy aspects relevant to the demands of SPLDV (Agustini & Pujiastuti, 2020; OECD, 2019).

Based on this gap, the present study is positioned to strengthen applied evidence regarding the role of mathematical literacy in learning outcomes on the SPLDV topic. The novelty of the study lies in testing the influence of mathematical literacy as a measurable construct—which includes the ability to formulate problems, apply procedures appropriately, and interpret results—on SPLDV learning outcomes, so that the findings do not stop at a list of difficulties, but provide an evidence-based foundation for improving literacy-oriented SPLDV instruction (OECD, 2019; Pradini et al., 2020). Practically, the results of this study are expected to help teachers determine instructional priorities: whether the decline in SPLDV achievement is more strongly triggered by weak modeling and interpretation skills (literacy), or by purely procedural weaknesses, so that instructional strategies can be designed more effectively and contextually.

Thus, the purpose of this study is to examine the influence of mathematical literacy on students' learning outcomes in the topic of Systems of Linear Equations in Two Variables (SPLDV). This focus is expected to contribute to the development of mathematics instruction that is more creative, contextual, and process-oriented—particularly in strengthening the ability to understand contexts, construct models, solve accurately, and interpret results meaningfully in SPLDV learning.

METHODS

This study employed a quantitative approach with a correlational research design. It aimed to determine the relationship and effect between mathematical literacy as the independent variable (X) and students' learning outcomes as the dependent variable (Y). The population of this study consisted of all eighth-grade students of SMP Negeri 1 Linggo Sari Baganti. The sample was selected using purposive sampling, namely the 26 students of the advanced eighth-grade class.

The instruments used in this study consisted of a mathematical literacy questionnaire and a learning outcomes test on the topic of systems of linear equations in two variables. The mathematical literacy questionnaire was developed based on mathematical literacy indicators, while the learning outcomes test

consisted of essay questions on systems of linear equations in two variables. The data analysis techniques included descriptive statistical analysis, Pearson correlation test, and simple linear regression analysis. All data analyses were conducted at a 5% significance level.

Data Collection Technique

A mathematical literacy questionnaire was used to measure the independent variable (X). It was developed based on mathematical literacy indicators, including understanding contextual problems, formulating mathematical models, using mathematical concepts and procedures, and interpreting results. The questionnaire used a four-point Likert scale: strongly agree, agree, disagree, and strongly disagree. Each item was designed to reflect students' ability to apply mathematics in daily life contexts, especially in the topic of systems of linear equations in two variables.

Instrument Validity and Reliability

The mathematical literacy questionnaire used in this study had undergone content validation by mathematics education experts. This validation was carried out to ensure that each statement item was aligned with the indicators of mathematical literacy. In addition, the instrument was constructed using language that was easy for junior high school students to understand, so that it could measure mathematical literacy ability optimally.

Table 1. Scoring of the Mathematical Literacy Questionnaire

Response Option	Positive Statement Score	Negative Statement Score
Strongly Agree (SA)	5	1
Agree (A)	4	2
Undecided (U)	3	3
Disagree (D)	2	4
Strongly Disagree (SD)	1	5

The total mathematical literacy score was obtained by summing the scores of all questionnaire items. The resulting score was then converted into categories representing students' levels of mathematical literacy.

Table 2. Categories of Mathematical Literacy Levels

Score Range	Category
Score > 80%	High
60% ≤ Score < 80%	Moderate
Score < 60%	Low

SPLDV Learning Outcomes Test to measure the dependent variable (Y). The topic of systems of linear equations in two variables is an important part of junior high school mathematics learning that requires logical and analytical thinking skills. In this topic, students are expected to identify variables, construct mathematical models, and interpret the solutions obtained. Therefore, mastery of mathematical literacy is an important prerequisite for understanding SPLDV material. Data analysis included descriptive analysis, Pearson correlation test, and simple linear regression analysis at a significance level of 0.05.

RESULT AND DISCUSSION

The data analyzed in this study consisted of two types of data, namely mathematical literacy scores and students' learning outcomes. The mathematical literacy scores were obtained through the distribution of questionnaires to students as the instrument for measuring the independent variable. The questionnaire was developed based on mathematical literacy indicators relevant to students' ability to understand and use mathematics. Meanwhile, students' learning outcome scores were obtained through a test on the topic of Systems of Linear Equations in Two Variables (SPLDV) as the dependent variable. The test results were used to determine the level of students' mastery of the material that had been taught. Both sets of data were then

analyzed to examine the relationship and effect between mathematical literacy and students' learning outcomes. Thus, the data analysis was conducted to obtain a clear picture of the contribution of mathematical literacy to success in learning SPLDV. The following presents the results of students' mathematical literacy and learning outcomes.

Table 3. Students' Mathematical Literacy Scores and SPLDV Learning Outcomes

No	Student Code	Mathematical Literacy Score (X)	SPLDV Learning Outcome Score (Y)
1	S1	65	30
2	S2	64	40
3	S3	81	85
4	S4	88	55
5	S5	78	40
6	S6	81	60
7	S7	95	75
8	S8	65	5
9	S9	68	5
10	S10	85	25
11	S11	85	75
12	S12	87	10
13	S13	72	5
14	S14	75	60
15	S15	92	60
16	S16	91	85
17	S17	69	20
18	S18	86	60
19	S19	67	10
20	S20	78	80
21	S21	95	25
22	S22	80	76
23	S23	71	35
24	S24	78	55
25	S25	74	55
26	S26	93	66

Based on Table 3, which presents the mathematical literacy scores and SPLDV learning outcome test results of 26 students in the advanced eighth-grade class of SMPN 1 Linggo Sari Baganti, it was found that both the mathematical literacy scores and learning outcome scores varied. The students' mathematical literacy scores ranged from 64 to 95, while the SPLDV learning outcome scores ranged from 5 to 85. This variation in the data indicates differences in students' mathematical literacy and learning outcomes.

Descriptive Statistical Analysis

Based on the results of data processing, the descriptive statistics of mathematical literacy and students' learning outcomes were obtained as presented in Table 4.

Table 4. Descriptive Statistics of Mathematical Literacy and Learning Outcomes

Variable	N	Minimum Score	Maximum Score	Mean
Mathematical Literacy (X)	26	64	95	79.54
SPLDV Learning Outcomes (Y)	26	5	85	47.88

The mean score of mathematical literacy indicates that students' mathematical literacy ability was in the moderate category. This suggests that most students were able to understand and use mathematical concepts in certain contexts, although they still experienced difficulties in interpreting and evaluating solution results in depth. Meanwhile, the mean score of SPLDV learning outcomes indicates that students' ability to solve

SPLDV problems was in the fair to good category. The differences in scores among students show variations in ability, which were influenced by each student's level of mathematical literacy.

Table 5. Categories of Students' Mathematical Literacy Levels

Score Range	Number of Students	Category
≥ 80	15	High
60–79	11	Moderate
< 60	0	Low
Total	**26**	

Based on Table 5, most of the advanced eighth-grade students of SMP Negeri 1 Linggo Sari Baganti had a high level of mathematical literacy. However, the students' SPLDV learning outcomes still showed considerable variation. This indicates that mathematical literacy is an important factor, although there are still other factors that also influence students' learning outcomes.

Pearson Correlation Test

The Pearson correlation test was used to determine whether there was a relationship between the independent variable, namely mathematical literacy (X), and the dependent variable, namely SPLDV learning outcomes (Y). This test also aimed to identify the direction and the strength of the relationship between the two variables. The Pearson correlation coefficient ranges from -1 to +1, where a positive value indicates a direct relationship, a negative value indicates an inverse relationship, and a value close to zero indicates a weak relationship.

Table 6. Results of the Pearson Correlation Test

Variable	Correlation Coefficient (r)	Sig. (p)	Description
Mathematical Literacy (X) – SPLDV Learning Outcomes (Y)	0.52	0.007	Moderate Positive Correlation

The results of the Pearson correlation test showed a correlation coefficient of r = 0.52 with a significance value of p = 0.007, indicating a moderate positive relationship between mathematical literacy and SPLDV learning outcomes. This finding means that the higher the students' mathematical literacy, the higher the tendency of their learning outcomes to be. This result is in line with the (OECD, 2023) framework, which emphasizes that mathematical literacy includes the ability to formulate, use, and interpret mathematics in various contexts. In the SPLDV topic, this ability is reflected when students must transform contextual situations into equation models, choose the appropriate solution procedures, and then reinterpret the results according to the meaning of the problem.

Simple Linear Regression Test

The simple linear regression test was used to determine whether the independent variable, namely mathematical literacy (X), affects the dependent variable, namely SPLDV learning outcomes (Y). This analysis was also used to identify the direction of the effect as well as the magnitude of the contribution of variable X to Y. The simple linear regression model is expressed in the equation Y = a + bX, where Y is the learning outcome, a is the constant, b is the regression coefficient, and X is mathematical literacy. The following are the results of the simple linear regression test.

Table 8. Results of the Simple Linear Regression Test

Model	Coefficient
Constant (a)	-64.92
Regression Coefficient (b)	1.40
R	0.52
R Square (R^2)	0.266
Sig.	0.007

The results of the simple linear regression analysis produced the equation Y = -64.92 + 1.40X with R^2 = 0.266 and Sig. = 0.007. This indicates that mathematical literacy has a significant effect on SPLDV learning outcomes, and that every one-point increase in mathematical literacy score is followed by an increase of approximately 1.40 points in learning outcomes. However, the value of R^2 = 0.266 also shows that mathematical literacy explains only 26.6% of the variance in learning outcomes, while the remaining variance is influenced by other factors. This explanation is supported by (Akras & Pujiastuti, 2025; Alreshidi, 2023; Kristiani, 2023), who showed that topic-specific prior knowledge affects mathematics achievement, and by (Sigus & Mädamürk, 2025), who found that motivation and extra-mathematical knowledge are also positively related to the ability to solve context-based problems. This finding is also in line with the studies of (Hulu et al., 2024; Rosiana, 2024), which stated that mathematical literacy skills have a positive effect on students' mathematics learning outcomes.

The moderate level of relationship indicates that mathematical literacy is indeed important, but its effect does not operate independently. (Chan & Kwan, 2021; Kurniawati et al., 2025) explained that success in solving mathematical word problems is influenced by the ability to construct problem schemas and understand mathematical vocabulary. This finding is important in interpreting the results of this study, because in SPLDV students are not only required to perform calculations; they must also understand information, recognize relationships between variables, and construct correct models. Thus, students with fairly good literacy scores may still obtain low SPLDV scores if they fail to read the structure of the problem, incorrectly construct the model, or misinterpret the final answer. The same point was also emphasized by (Fuchs et al., 2020; Nurhalin & Effendi, 2022), who showed that schema-based instruction combined with language comprehension support provides clear benefits in solving word problems.

More broadly, the findings of this study are consistent with the research synthesis conducted by (Kappassova et al., 2025; Putri et al., 2024). They showed that over the last decade, mathematical literacy, achievement, and problem-solving have been among the most closely related themes in mathematics education research, and that algebra is one of the dominant domains. In the context of SPLDV, this is reasonable because the topic inherently requires translation from real-life contexts into symbolic form. In line with this, (Atuni et al., 2023; Fimillatika & Haerudin, 2023) also emphasized that systems of linear equations in two variables are closely related to everyday problems, so mastery of mathematical literacy is very important for understanding and solving them accurately.

The implication is that improving SPLDV learning outcomes cannot rely solely on procedural practice. Teachers need to develop instruction that provides greater opportunities for contextual problems, mathematical modeling, strategy discussion, and result interpretation. This recommendation is consistent with the findings of (Maysarah et al., 2025; Vessonen et al., 2025), who showed that the effectiveness of word problem-solving interventions is influenced by instructional quality, fidelity of implementation, practice dosage, and instrument characteristics. In other words, the better the quality of contextual problem-based instruction, the greater the opportunity for students to strengthen their mathematical literacy while also improving their SPLDV learning outcomes.

CONCLUSION

Berdasarkan hasil penelitian, dapat disimpulkan bahwa terdapat pengaruh yang signifikan antara literasi matematika terhadap hasil belajar siswa pada materi SPLDV. Semakin tinggi literasi matematika siswa, maka semakin tinggi pula hasil belajar yang diperoleh. Oleh karena itu, guru disarankan untuk mengembangkan pembelajaran yang dapat meningkatkan literasi matematika siswa.

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