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Improving Students' Mathematical Literacy Skills Through the Application of Genially in the PBL Model

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ABSTRACT

The purpose of this study was to determine the improvement of students' mathematical literacy skills through the application of genially on problem-based learning (PBL) model. This research was conducted at SMA Negeri 6 Garut. The research method used was quasi experimental with pretest-posttest control group design. The experimental class was given treatment by applying genially to the problem-based learning (PBL) model while the control class was given the problem-based learning (PBL) model only. The population in this research were all students of class X, with a sample of two classes namely class X 12 as the experimental class and class X 4 as the control class. sampling based on the random assignment technique. The data collection techniques used were observation, unstructured interview, and mathematical literacy test. The instruments used were student mathematical literacy test. The data analysis technique used the Two Independent Samples Test. Based on the results of data analysis, it can be concluded that there is an increase in students' mathematical literacy skills through the application of Genially in the Problem Based Learning (PBL) model with a significance of 0.03.

Keywords: mathematical literacy skills; genially; problem-based learning model

INTRODUCTION

Education is a conscious effort to realize a cultural inheritance from one generation to another (Aziz et al., 2025; Imswatama & Saepuloh, 2025; Lestari et al., 2024; Rahman et al., 2022). In addition, Education is defined as a deliberate effort by families, communities, and governments to develop individual potential through learning or training processes, both inside and outside school, in formal, non-formal, and informal settings (Ginting et al., 2025). According to Law Number 20 of 2003, education is a conscious and planned effort to create a learning atmosphere the enables students to actively develop their potential, including spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves and society. Therefore, education plays a crucial role in shaping individual's quality and character

Mathematics is one of the fundamental disciplines that support the advancement of science and technology and plays a central role in various fields (Mulana, 2021). Despite the rapid development of technology, the role of mathematics remains essential in everyday life (Siregar & Dewi, 2022). Mathematics education provides a strong foundation for individuals to understand and master modern and to participate in an increasingly complex and data-driven society. In the learning process, mathematics education involves students in communication and problem-solving activities to develop their mathematical abilities (Wedekaningsih et al., 2019). The objectives of mathematics learning, as stated in

Permendiknas Number 22 of 2006, include understanding mathematical concepts, using reasoning, solving problems, communicating ideas, and developing positive attitudes toward mathematics. These competencies are closely related to student's mathematical literacy skills, which are essential in applying mathematics to real-life contexts.

However, the reality shows that student's mathematical literacy skills are still relatively low. Based on the results of an interview conducted with a mathematics teacher of grade X at SMA Negeri 6 Garut, it was found that although the school has implemented an independent curriculum, students' mathematical literacy abilities remain insufficient. The average level of students' mathematical literacy is around 40, indicating that many students still experience difficulties in understanding problems, identifying relevant information, transforming problems into mathematical representations, and performing appropriate calculations.

The low level of mathematical literacy can be influenced by several factors, including students' limited understanding of concepts when dealing contextual problems that require reasoning, argumentation, and creativity (Rodhi, 2021). Mathematical literacy itself is defined as the ability to formulate, use, and interpret mathematics in a various context (Atho'illah et al., 2022). Therefore, improving students' mathematical literacy requires appropriate learning strategies and innovations, including the integration of technology in the learning process (Yani et al., 2025).

The rapid development of digital technology, particularly the widespread use of smartphones among students, provides opportunities to enhance learning processes (Jufri, 2022). One of the digital learning media that can be utilized is a Genially, which enables educators to create interactives and visually engaging learning materials such as presentations, infographics, and quizzes (Enstein et al., 2022; Rahmi et al., 2023; Septian et al., 2022). The use of such media is expected to increase students' motivation and engagement, which in turn may contribute to the improvement of their mathematical literacy skills (Ramadhan et al., 2023).

In addition to learning media, the selection of an appropriate learning model is also an important factor in achieving learning objectives (Rizki et al., 2023). One of the models that can be applied in mathematics learning is Problem Based Learning (PBL), which emphasizes students-centered learning through real-life problem-solving activities (Marwa et al., 2023). However, previous studies indicate that the effectiveness of the PBL model may be limited if students lack learning motivation (Wulandari et al., 2023). Therefore, further development is needed to optimize the implementations of PBL, particularly by integrating it with interactive digital media (Paloloang et al., 2020).

Based on these considerations, this study aims to examine the improvement of students' mathematical literacy skills through the application of Genially in the Problem Based Larning (PBL) model for grade X students at SMA Negeri 6 Garut.

RESEARCH METHODS

This study uses quantitative research methods. The quantitative research method used is quasi-experiment research, which is an approach that has a control group, but cannot function fully to control external variables that affect the implementation of the experiment (Sugiyono, 2022, p. 77). In this study, the population included all students of class X SMA

Negeri 6 Garut who were enrolled in the 2024/2025 school year. In determining the sample, the researcher used the random assignment technique, which is a sampling technique in which each object has the same opportunity. In this study, class X-12 was selected as the experimental class, while class X-4 was selected as the control class. The experimental class was given treatment by applying genially to the problem-based learning (PBL) model while the control class was given the problem-based learning (PBL) model only.

Data collection can be done in various settings, various sources, and various ways (Sugiyono, 2022, p. 137). In this study, the data collection techniques used were tests and non-tests. The test was held twice (pretest-posttest) to evaluate the improvement of students' mathematical literacy skills. used to assess mathematical literacy skills. Data analysis techniques in the form of descriptive statistics and inferential statistics by analyzing N-Gain data and posttest results of students' mathematical literacy skills. Normality test using Shapiro Wilk, continued homogeneity test using Levene's and two means test (right side) using Two Independent Sample Test. The non-test instrument used in this study was a questionnaire. In this study, researchers gave questionnaires directly to experimental and control class students to find out the learning motivation of students in the mathematics learning process.

RESULTS AND DISCUSSION

Data collection was conducted using a test consisting of two tests: a pretest and a posttest. The pretest aimed to measure students' initial knowledge before the implementation of the treatment on the topic of linear equations and inequalities. After completing the pretest, students were given treatment through the Problem Based Learning (PBL) model supported by Genially (Experimental Class). The tests were administered face-to-face (offline) to ensure direct supervision by the researcher. The descriptive statistics of the pretest and posttest scores in both the experimental and control classes are presented in Table 1.

Table 1. Results of N-gain Data Analysis in Experimental and Control Classes

	Experiment Class	Control Class
N	32	31
Range	1.35	0.66
Minimum	-0.50	-0.11
Maximum	0.85	0.55
Mean	0.39	0.22
Std. Deviation	0.33	0.19
Variance	0.11	0.04

Table 1 shows that the experimental class has a higher mean score (0.39) compared to the control class (0.22). In addition, the standard deviation in the experimental class (0.33) is higher than in the control class (0.19), indicating greater variation in student performance. Before conducting hypothesis testing, prerequisite tests were carried out, including normality and homogeneity tests. The results of the normality test using the Shapiro-Wilk test are presented in Table 2.

Table 2. Normality Test Results of Mathematical Literacy Ability of Students

Class	Shapiro-Wilk	Description

	Statistic	df	Sig	
Experiment	0.10	32	0.10	Normality distributed
Control	0.16	31	0.06	Normality distributed

Based on table 2, the significance values for both the experimental class (0,10) and the control class $0.06 \geq 0.05$ then H_0 is accepted. Therefore, it can be concluded that the data from both classes are normally distributed, then the homogeneity test is used. The homogeneity test used in this study is Levene's test with a significance level of 5%. The results of the homogeneity test using Levene's are presented in Table 3.

Table 3. Results of Homogeneity Test of Mathematical Literacy Ability of Students

	Levene Statistic	df1	df2	Sig	
Score	6.48	1	61	0.01	Not Homogeneous

Based on table 3, the significance value is $0.01 < 0.05$. This indicates that the data are not homogeneous, the hypothesis test was conducted using the Independent Sample T-Test with unequal variances assumed. The results are shown in Table 4.

Table 4. Hypothesis Test of Students' Mathematical Literacy Ability

	Independent Samples Test		
	t	df	Sig.(2-tailed)
Equal variances assumed	2.23	61	0.03
Equal variances not assumed	2.25	49.18	0.03

Based on table 4the significance (2-tailed) value is $0.03 < 0.05$. Therefore, the null hypothesis H_0 is rejected and H_1 is accepted, indicating that there is a significant difference between the experimental and control classes.

The results indicate that the application of Genially in the Problem Based Learning (PBL) model contributes to an improvement in students' mathematical literacy skills. This improvement may be attributed to the interactive and visual nature of Genially, which enhances students' engagement and motivation during the learning process. When students are more engaged, they tend to better understand problems, identify relevant information, and apply appropriate mathematical concepts.

This finding is consistent with previous studies stating that digital learning media can increase students' motivation and participation in learning activities (Enstein et al., 2022; Ramadhan et al., 2023). Furthermore, the use of the PBL model encourages students to actively solve real-life problems, which supports the development of mathematical literacy skills, particularly in reasoning and problem-solving (Marwa et al., 2023).

However, the results also show that the data were not homogeneous, which may indicate differences in students' initial abilities or learning conditions between the two classes. This suggests that external factors, such as student background or learning environment, may also influence the results. In addition, this study has several limitations. First, the sample size was limited to one school, which may affect the generalizability of the findings. Second, the duration of the treatment was relatively short, so it may not fully capture long-term improvements in students' mathematical literacy. Future research is recommended to involve a larger sample and longer implementation period to obtain more comprehensive results.

The finding of this study are consistent with previous research conducted by Fitri et al. (2024), which demonstrated that the use of the Genially as a problem based learning model can improve students' mathematical literacy skills. This improvement is likely due to the interactive and visual features of Genially, which allow students not only to receive information passively but also to actively engage with the learning content. As a result, students can more easily understand problem contexts, identify relevant information, and relate it to mathematical concepts. In contrast, students in the control class, who only experienced the PBL model without the support of digital media, tended to face difficulties in visualizing problem situations. Without adequate visual support, students may struggle to interpret problems accurately, which can affect their ability to formulate, solve, and interpret mathematical problems effectively.

In addition hypothesis testing, further analysis was conducted on students' answer processes in solving contextual mathematical problems. The analysis results show that not only were the experimental class scores higher, but students were also better able to understand problem contexts, apply appropriate solution strategies, and explain their answers clearly and systematically. The comparison of students' mathematical literacy skills based on each indicator is presented in Figure 1.

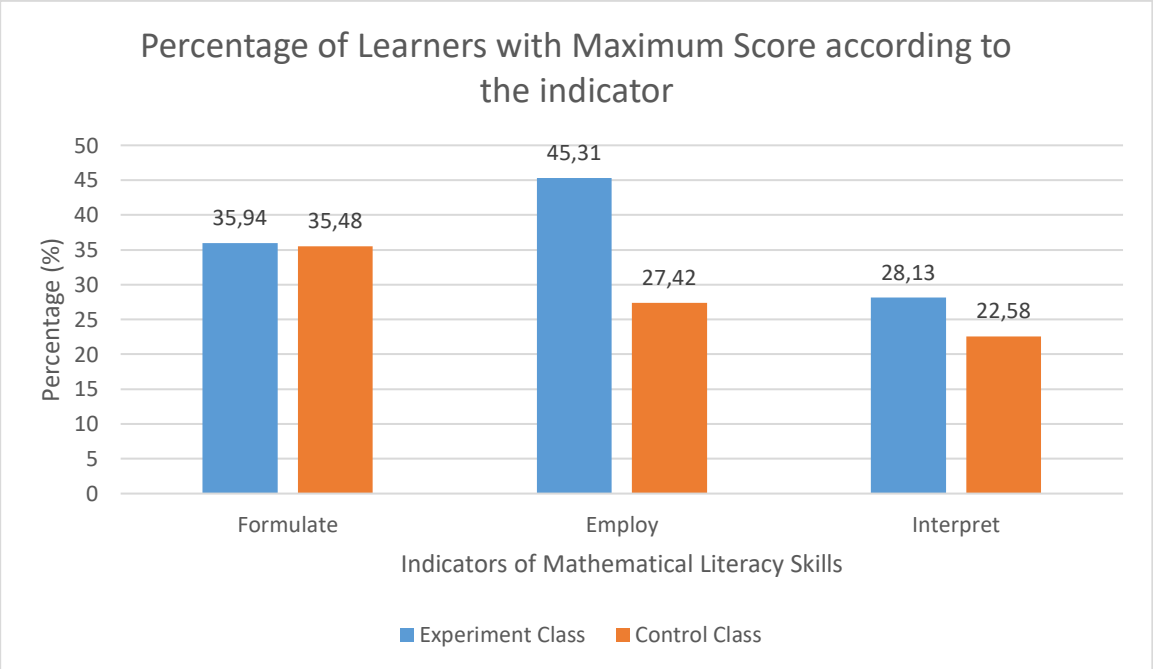


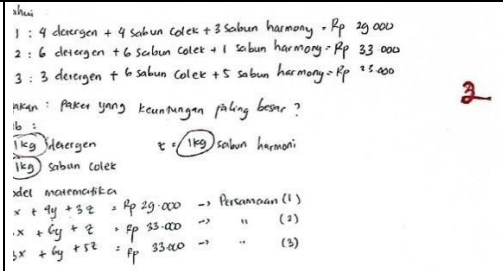
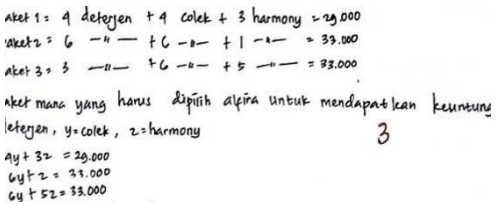
Figure 1. Percentage of Students Achieving Maximum Scores Based on Mathematical Literacy Indicators

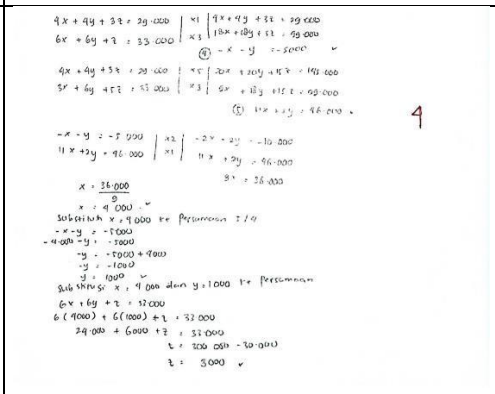
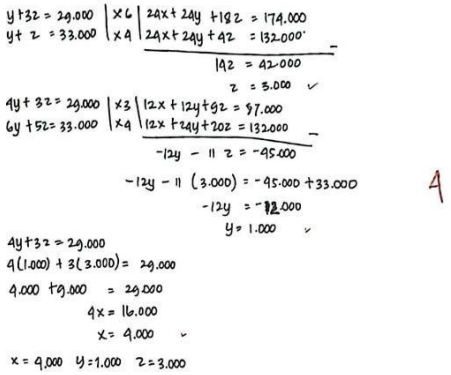
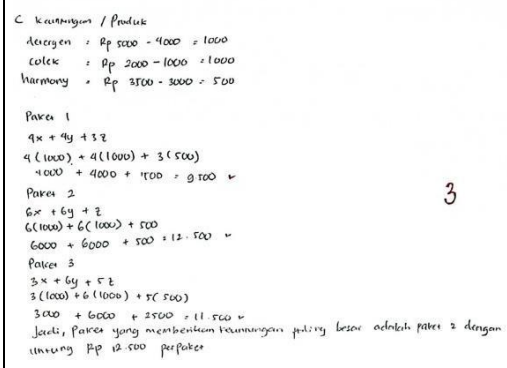
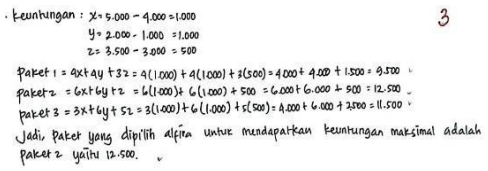
Based on Figure 1. differences between the experimental and control classes can be observed across three indicators: formulate. employ. and interpret. In the formulate indicator. both classes show relatively similar results. with the experimental class at 35.94% and the control class at 35.48%. This indicates that students in both groups have a comparable ability to identify and formulate problems. However. a more significant difference appears in the employ indicator. The experimental class achieved 45.31%. while the control class reached only 27.42%. This suggests that students in the experimental class are better at applying mathematical concepts and procedures to solve problems. This improvement may be

attributed to the use of Genially. which supports visualization and enhances conceptual understanding.

In the interpret indicator, the experimental class also outperformed the control class, with scores of 28.13% and 22.58%, respectively. This indicates that students in the experimental class are more capable of interpreting and evaluating the results of their solutions and relating them back to the problem context. To further support these findings, examples of students' answer processes are presented in Table 5.

Table 5. Example of Students' Answer Completion Process related to Mathematical Literacy Problems

No.	Example of Students' Answer Completion Process	
	Control Class	Experiment Class
1.	 In the first indicator. namely formulating mathematical problems (formulate). students can already write what is known and asked in the problem completely and correctly. It is clearly seen that students are able to write the known information in the problem completely. namely: package 1: 4 detergents. 4 soaps. and 3 harmony soaps for Rp29.000; package 2: 6 detergents. 6 soaps. and 1 harmony soap for Rp33.000; and package 3: 3 detergents. 6 soaps. and 5 harmony soaps for Rp33.000. Learners have also been able to write the question asked in the problem correctly. that is: if "Which package has the greatest advantage?" However. students make mistakes in generalizing the problem into mathematical language. In the problem it is written that x = 1 kg of detergent. while in the problem the unit of detergent is not kg. As for formulating the problem into a mathematical model. students are correct. Therefore. the	 In the first indicator. namely formulating mathematical problems (formulate). students can already write what is known and asked in the problem completely and correctly. It is clearly seen that students are able to write the known information in the problem completely. namely: package 1: 4 detergents. 4 soaps. and 3 harmony soaps for Rp29.000; package 2: 6 detergents. 6 soaps. and 1 harmony soap for Rp33.000; and package 3: 3 detergents. 6 soaps. and 5 harmony soaps for Rp33.000. Learners have also been able to write the question asked in the problem correctly. Learners have also been able to write the question asked in the problem correctly. namely: "Which package should Alfira choose to get maximum profit?" In addition. learners have been able to formulate the problem into a mathematical model correctly. Therefore. these learners obtained the maximum score of 3 for this indicator.

	learner obtained a score of 2 for this indicator.	
2.	 In the second indicator. namely using mathematical concepts. facts. procedures and reasoning (employ). Learners use the right strategy and carry out calculations clearly and correctly. It can be seen that the purchase price of detergent (x) is obtained Rp. 4.000. soap powder (y) is obtained Rp. 1.000. and harmony soap (z) is obtained Rp. 3.000. In this class. learners tend to solve regularly according to the example exercises that have been done. So they are not open to other ways that can be modified so that it can be solved briefly.	 In the second indicator. namely using mathematical concepts. facts. procedures and reasoning (employ). Learners use the right strategy and carry out calculations clearly and correctly. It can be seen that the purchase price of detergent (x) is obtained Rp. 4.000. soap powder (y) is obtained Rp. 1.000. and harmony soap (z) is obtained Rp. 3.000. In this class. students tend to solve briefly and look for variables that are easy to find.
3.	 In the third indicator. namely drawing conclusions and reinterpreting the results of solving mathematical problems into a real-world context (Interpret). Learners provide complete responses with clear enough explanations or information. presenting arguments that are logical and complete enough to draw a conclusion. It can be	 In the third indicator. namely drawing conclusions and reinterpreting the results of solving mathematical problems into a real-world context (Interpret). Learners provide complete responses with clear enough explanations or information. presenting arguments that are logical and complete enough to draw a conclusion. It can be seen that students write the profit of each item. namely for detergent (x) of Rp. 1.000. colek soap (y) of Rp. 1.000. and

	seen that students write the profit of each item. namely for detergent (x) of Rp. 1.000. colek soap (y) of Rp. 1.000. and harmony soap (z) of Rp. 500. Therefore. learners obtained a score of 3 for this indicator.	harmony soap (z) of Rp. 500. Therefore. learners obtained a score of 3 for this indicator.

Based on Table 5, it can be concluded that the students' problem-solving processes related to mathematical literacy in the experimental class are better than those in the control class.

In the first indicator (formulate), students in the experimental class were able to identify and write down the known information and questions completely and correctly. They were also able to represent the problem into an appropriate mathematical model without errors in the use of units or variable generalization. In contrast, although students in the control class were generally able to identify the known information and questions, some errors were found in variable generalization, such as the inappropriate use of the unit "kg" for detergent, which was inconsistent with the problem context.

Improvements in the experimental class were also evident in the second indicator (employ). Students not only applied appropriate solution strategies but also demonstrated the ability to select more efficient approaches. They tended to solve problems concisely by choosing suitable variables and performing accurate calculations without unnecessary repetition of procedures. This indicates that students were not merely following memorized steps, but were able to understand the meaning of the given information and process it logically.

On the other hand, students in the control class tended to rely on previously practiced solution patterns. Their problem-solving processes were generally more linear and lengthy, as they attempted to replicate familiar procedures, even when more efficient alternatives were available. This suggests that their approach was more procedural rather than conceptual, with limited flexibility in adapting strategies to the problem context.

Therefore, the improvement of students' mathematical literacy skills through the application of Genially in the Problem Based Learning (PBL) model is reflected not only in the final results but also in the quality of the problem-solving process. Students in the experimental class demonstrated more structured, efficient, and flexible thinking. They were able to justify the steps taken and select the most appropriate strategies based on the problem context. In contrast, the control class showed a tendency toward procedural thinking, which may limit the development of deeper conceptual understanding and mathematical literacy skills.

CONCLUSION

his study concludes that there is a significant improvement in students' mathematical literacy skills through the application of Genially in the Problem Based Learning (PBL) model. This is supported by the results of the independent samples t-test, which show that the significance value (Sig. 2-tailed) is 0,03 < 0,05. Therefore, the null hypothesis H_0 is rejected and the alternative hypothesis H_1 is accepted. These findings indicate that the

application of Genially within the Problem Based Learning (PBL) model is more effective in improving students' mathematical literacy skills compared to the use of the PBL model without the support of Genially.

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