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Students' Mathematical Literacy Skills Through Contextual Teaching and Learning and Problem-Based Learning Models

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ABSTRAK

Kemampuan literasi matematis siswa merupakan salah satu kemampuan kognitif yang penting untuk dikuasai oleh siswa. Berdasarkan PISA 2022 menunjukkan Indonesia masih tergolong rendah. Tujuan penelitian untuk mengetahui apakah ada perbedaan kemampuan literasi matematis siswa antara siswa yang mendapatkan model Contextual Teaching and Learning (CTL) dan Problem Based Learning (PBL). Metode yang digunakan dalam penelitian ini adalah kuasi eksperimen dengan populasi yaitu siswa SMP kelas VIII pada salah satu sekolah di kabupaten Garut. Teknik pengambilan sampel pada penelitian ini adalah purposive sampling. Teknik pengumpulan data yang digunakan yaitu tes dan observasi. Teknik analisis data menggunakan uji t dan gain ternormalisasi. Hasil penelitian ini yaitu: Terdapat perbedaan kemampuan literasi matematis siswa antara yang mendapatkan model CTL dan PBL; Kualitas peningkatan kemampuan literasi matematis siswa kelas CTL termasuk pada kategori sedang; Kualitas peningkatan kemampuan literasi matematis siswa kelas PBL pada materi termasuk pada kategori sedang.

Kata Kunci: Literasi Matematis, *Contextual Teaching and Learning*, *Problem-Based Learning*

ABSTRACT

Students' mathematical literacy skills is one of the important cognitive skills that students need to master. According to PISA 2022, Indonesia is still categorized as having a low level of performance. The purpose of this study is to determine whether there is a difference in students' mathematical literacy abilities between those who received the Contextual Teaching and Learning (CTL) model and those who received the Problem-Based Learning (PBL) model. The method used in this study is a quasi-experiment with the population being 8th-grade junior high school students at a school in Garut Regency. The sampling technique used in this study is purposive sampling. The data collection techniques used are tests and observations. Data analysis techniques include the t-test and normalized gain. The results of this study are: There is a difference in students' mathematical literacy skills between those who received the CTL model and those who received the PBL model; The improvement in mathematical literacy skills of students in the CTL class is in the medium category; The improvement in mathematical literacy skills of students in the PBL class is also in the medium category.

Keywords: Mathematical Literacy, Contextual Teaching and Learning, Problem-Based Learning

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1. INTRODUCTION

Mathematics is one of the essential sciences to master because it has many benefits in real life, such as for transactions and other activities. Although mathematics offers many advantages for everyday life, most students tend to dislike it because they perceive it as a difficult subject—full of formulas, calculations, and abstract thinking. Reading and writing are essential skills that serve as tools for learning mathematics. These skills are crucial for students' success in life and are strengthened through literacy.

According to the Indonesian Dictionary (KBBI), literacy is defined as the ability to see and understand the content of what is written, to spell or pronounce what is written, to speak, to know, to predict, to estimate, and to calculate (Isnaniah et al., 2021). Literacy ability has become one of the key elements in facing an ever-changing society (Janah et al., 2019). This is because the development of logical reasoning in both literacy and mathematics requires the ability to think logically and critically, analyze information, and draw conclusions.

The importance of literacy skills lies in the ability to effectively communicate mathematical concepts, both orally and in writing. Mathematical literacy refers to an individual's ability to formulate, use, and interpret mathematics through reasoning, applying concepts, and using mathematical ideas in various contexts (Fathani, 2016: 136; Abidin, 2018: 100). Mathematical literacy plays a crucial role in understanding the usefulness of mathematics in everyday life (Putra & Vebrian, 2019). According to the OECD (2023), there are three main indicators of mathematical literacy skills used as the basis for the PISA 2022 assessment, which are as follows (see Table 1).

Table 1. Indicators of Mathematical Literacy Skills

Stage of Literacy Skills / Literacy Skill Stages	Indicators
Formulating situations mathematically	Students are able to identify where they need to apply relevant mathematics to analyze, structure, and solve problems. They must be capable of translating real-world problems into the mathematical domain using mathematical structures. Students should also be able to think about and understand the constraints and assumptions within a problem. The process of formulating situations mathematically includes the following activities: a. Selecting a model that is appropriate for the presented problem b. Identifying the mathematical aspects of a given problem and translating them into relevant mathematical variables c. Simplifying the situation or problem to make it analyzable in mathematical terms, such as by breaking it down d. Making basic assumptions or creating a set of instructions or steps to assist in solving the problem

Stage of Literacy Skills / Literacy Skill Stages	Indicators
Applying mathematical concepts, facts, and procedures. Students demonstrate the ability to perform the necessary steps to derive results and arrive at mathematical solutions, including performing calculations, solving equations, and carrying out other mathematical operations.	Students demonstrate the ability to perform the necessary steps to derive results and arrive at mathematical solutions, including performing calculations, solving equations, and carrying out other mathematical operations. Students work with models of problem situations, identify patterns, recognize relationships between mathematical elements, and construct mathematical arguments. In practice, this process includes the following activities: a. Performing basic calculations b. Drawing simple conclusions c. Choosing appropriate strategies d. Using mathematical tools, such as technology, to assist in finding accurate or approximate solutions e. Applying mathematical facts, rules, and structures when seeking solutions f. Interpreting information, making generalizations and estimations based on the results of applying mathematical procedures to find solutions g. Considering conjectures, and explaining and justifying the mathematical results obtained
Interpreting, Applying, and Evaluating Mathematical Outcomes	a. Students are expected to construct and communicate explanations based on the solutions they produce. This process includes the following activities: Explaining the mathematical results in the context of the real world b. Justifying or evaluating the solution by providing supporting arguments, as well as testing and comparing proposed solutions

According Kemendikbud (2020), students' mathematical literacy skills at the junior and senior high school levels are still low. Damanik and Handayani (2023) stated that students' mathematical literacy ability is still low. The research results of Masfufah and Afriansyah (2021) show that students' mathematical literacy ability is still considered low, as they continue to struggle with PISA questions at levels 1 and 2. Students' literacy abilities in the Program for International Student Assessment (PISA) are divided into six levels, where Level 1 represents the lowest level of achievement and Level 6 represents the highest. According to the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek), the results of the PISA 2022 study show that Indonesia's literacy learning outcomes improved by 5 to 6 positions compared to PISA 2018. Indonesia ranked 68th with scores of 379 in mathematics, 398 in science, and 371 in reading. However, the average results still show a decline (learning loss) of around 12 – 13 points compared to 2018, mainly due to the impact of the COVID-19 pandemic, and the scores remain relatively low. According to research (Santia, 2018; Fatwa et al., 2019; Paloloang et al., 2020; Fitni et al., 2023), the low level of students' mathematical literacy is influenced by the learning steps or instructional models used in the classroom—particularly the use of unengaging math teaching methods that are still teacher-centered. Choirunisa and Waluya (2024) stated that

the level of students' mathematical literacy ability can be influenced by the model and approach used during the learning process. Therefore, in mathematics instruction, teachers need to guide and provide opportunities for students to communicate their understanding by making connections between the subject matter and its real-world applications. This enables students to solve problems both individually and in groups.

One instructional model that encourages active student participation and provides meaningful learning is Contextual Teaching and Learning (CTL), as well as Problem-Based Learning (PBL). Both of these learning models can be used to improve students' mathematical literacy and share a similar foundation in student-centered, real-world-context-oriented approaches. They also both emphasize the development of problem-solving skills, which is a crucial aspect of mathematical literacy, making them highly relevant for enhancing students' literacy skills in mathematics.

According Nanda and Hoiriyah (2024) showed that the CTL model has a significant effect on the mathematical literacy ability of 7th-grade junior high school students, Khamid and Santosa (2016: 116) stated that CTL is an instructional approach that enables a learning process in which students apply their understanding and academic skills in various contexts—both within and outside of school—to solve problems, whether simulated or real, either individually or collaboratively. In line with the view of Rahmawati and Fasha (2023), there is a positive influence of process skills when using the CTL model on improving students' mathematical literacy skills, and the CTL model is considered effective in the learning process.

Meanwhile, the PBL model presents students with authentic and meaningful problems, which encourage them to engage in inquiry and discovery activities (Khamid & Santosa, 2016: 112). According to a study conducted by Kusumawati, Purwosetiyono, and Handayani (2024), the use of the PBL model is more effective in improving students' mathematical literacy skills. The study conducted by Pamungkas and Franita (2019) showed that PBL can improve mathematical literacy skills. Tabun, Taneo, and Daniel (2020) stated that students' mathematical literacy ability in classes that received the PBL model was better than in classes that did not receive the PBL model.

Based on the explanation above, it is stated that both CTL and PBL models can enhance students' mathematical literacy skills. Therefore, the researcher is interested in exploring whether there is a difference in students' mathematical literacy skills between the two learning models—CTL and PBL; how the quality of improvement differs among students who are taught using the CTL model; and how the improvement in literacy skills compares for students who are taught using the PBL model. Based on this background, the researcher is interested in conducting a study entitled: "Students' Mathematical Literacy Skills Through Contextual Teaching and Learning and Problem-Based Learning Models." Based on the author's review, research on this

topic has not yet been conducted, making this study a new contribution. It is expected to provide insights and support efforts to enhance students' mathematical literacy skills.

2. METHOD

The type of research conducted by the researcher is quantitative research. The research method used is a quasi-experimental method. This study focuses on observing the mathematical literacy skills of 8th-grade junior high school students through the Contextual Teaching and Learning and Problem-Based Learning models on the topic of Systems of Linear Equations in Two Variables (SPLDV). The research involves two experimental classes and uses a pretest-posttest non-equivalent comparison group design. For more details, the research design according to Ruseffendi (as cited in Asmara, 2015) is as follows (see Figure 1).

O	X_1	O
O	X_2	O

Figure 1. Research Design

Explanation:
O : Pretest and posttest instruments
X_1 : Treatment using the CTL (Contextual Teaching and Learning) model
X_2 : Treatment using the PBL (Problem-Based Learning) model
------: Quasi-experiment

This research was conducted in November 2024 during the 2024/2025 academic year. The population in this study consists of all 8th-grade junior high school students at a school in Garut Regency. The sample used includes class VIII-F, which received the CTL model, and class VIII-H, which received the PBL model. The sampling technique applied was purposive sampling. Data collection techniques used in this study included a mathematical literacy skills test and observation. The instruments used consisted of a mathematical literacy test sheet comprising four essay-type questions, as well as observation sheets for both teachers and students. The data analysis involved calculations for reliability, validity, item difficulty level, and discriminating power of the test items, based on the formulas and criteria by Sundayana (2018), using Microsoft Office Excel. The data analysis techniques used in this study consisted of descriptive analysis and statistical analysis.

3. RESULTS AND DISCUSSION

In this study, the indicators and levels of mathematical literacy skills refer to those proposed by the OECD (2023), which consist of three indicators: Formulating situations

mathematically; Using mathematical concepts, facts, and procedures; and Interpreting, applying, and evaluating mathematical outcomes. In terms of levels, the researcher used levels 1 to 5.

a. Research Results

The research results include the outcomes of the pretest and posttest from the mathematical literacy skills test instrument, which is divided into three indicators.

Table 1. The Outcomes of The Mathematical Literacy Skills Test Instrument

Model	n	Ideal Score	*Pretest*				*Posttest*				Gain
			$xmin$	$xmaks$	$\overline{x}$	S	$xmin$	$xmaks$	$\overline{x}$	S	
CTL	34	40	5	16	10,88	3,26	22	40	30,71	5,40	0,68
PBL	32		5	16	10,69	3,51	16	40	26,59	6,31	0,54

Based on the pretest scores, it can be concluded that there is no significant difference in the initial mathematical literacy ability between students who received the CTL model and those in the PBL class. Therefore, both classes have similar initial levels of mathematical literacy ability.

The Table 1 shows that the average posttest score in the CTL class is higher than that in the PBL class. The data from both classes were tested for normality using the Liliefors Test at a 5% significance level. A homogeneity test was then conducted, which indicated that the data distribution was homogeneous, allowing the use of a t-test. Using a two-tailed t-test with $\propto = 0.05$, the result yielded a t-table value of 2.00 and a calculated t-value (t_h) of 2.85. Since the t-value falls outside the acceptance region for H_0, namely $-2.00 \leqslant t \leqslant 2.00$, it can be concluded that there is a significant difference in mathematical literacy skills between students who received the Contextual Teaching and Learning model and those who received the Problem-Based Learning model.

The quality of improvement in mathematical literacy ability for students who received the CTL learning model can be determined by calculating the normalized gain from the pretest and posttest data. The results of the normalized gain calculation in the CTL class show an average score of 0.68, which falls into the medium category, while the PBL class shows an average score of 0.54, also categorized as medium.

b. Discussion

The pretest results showed that the average score of students' mathematical literacy skills in the CTL class was 10.88, while in the PBL class, the average was 10.69. The difference between the two pretest averages is relatively small, at 0.19. This indicates that the students' initial abilities before receiving the respective treatments in each class were not significantly different. Therefore, it can be concluded that there was no difference in the initial mathematical

literacy skills between students who received the CTL model and those who received the PBL model.

After the pretest, both classes engaged in learning by applying the designated models. Class VIII-F received the CTL model, while class VIII-H received the PBL model. After undergoing instruction for four sessions, both classes were then given a posttest.

The posttest results in both studies showed an average difference of 4.12, with the average posttest score for students in the CTL class being 30.71, while the posttest score for students in the PBL class averaged 26.59. This data indicates that after applying different models in both classes, students' mathematical literacy skills showed a difference

Based on the pretest and posttest results, the researcher then conducted calculations to examine the difference in mathematical literacy skills using normality tests, homogeneity tests, and hypothesis tests. The results of the hypothesis testing showed that there is a significant difference in mathematical literacy skills between students who received the Contextual Teaching and Learning model and those who received the Problem-Based Learning model.

The hypothesis test results and the average scores from both experimental groups indicate that there is a difference in mathematical literacy skills between the Contextual Teaching and Learning model and the Problem-Based Learning model. Among the two models, the Contextual Teaching and Learning model was found to be more effective in improving students' mathematical literacy skills compared to the Problem-Based Learning model. This is because the learning process in the Contextual Teaching and Learning model was carried out more effectively, leading to better improvements in students' mathematical literacy skills. As a result, students demonstrated good mathematical literacy. This aligns with research by Putri, Hendriana, and Fitriana (2024), which shows that students who received the CTL model performed better in improving their mathematical literacy skills compared to students who received traditional learning methods.

Additionally, several factors contributed to the PBL model not being as effective as the CTL model in enhancing students' mathematical literacy skills. One factor was the inefficiency of the learning process in the classroom. This included incomplete implementation of certain steps and students' confusion in determining concepts and solving problems independently, as they were more accustomed to group problem-solving activities, which made it difficult for them to work individually. Furthermore, the learning environment and classroom conditions were less conducive.

Therefore, the researcher believes that several factors influenced the acceptance of the hypothesis in the test of differences in mathematical literacy skills between students who received the CTL model and those who received the PBL model. These factors can be divided into internal and external factors. The internal factors include anxiety, motivation, and student habits.

The external factors involve differences in learning styles or teaching models between the two classes, differences in interaction, and learning environment situations.

The improvement mathematical literacy skills that occurred in the CTL class was 0.68, which falls into the medium category. This means that the improvement in the CTL class indicates that the CTL model is a fairly effective learning model in enhancing students' mathematical literacy skills. The improvement in mathematical literacy ability may be attributed to the learning process that was implemented. Active learning made students feel challenged throughout the learning process, resulting in better mathematical literacy skills. This is in line with the opinion of Rahmawati and Fasha (2023), who stated that there is a positive effect of process skills using the CTL model on improving students' mathematical literacy ability, and that the CTL model is effective in the learning process.

The improvement in mathematical literacy skills in the PBL class was 0.54 and falls into the medium category. The literacy improvement score in the PBL class was lower than that of the CTL class. This is due to the fact that during the learning process using PBL, some students were still confused in determining concepts and solving problems independently, as they were more accustomed to working in groups. As a result, they experienced some difficulties when working individually, which affected their final (posttest) mathematical literacy scores. This finding differs from the results of the study conducted by Kusumawati, Purwosetiyono, and Handayani (2024), which stated that the use of the PBL model is more effective in improving mathematical literacy ability. Therefore, in the implementation of the PBL model, the teacher’ s role in providing guidance during the learning process needs to be optimized. As stated by Surtika and Supardi (2024), the PBL model is an effective method in mathematics learning when supported by teacher training for optimal implementation. This is because the PBL model is designed to encourage students to think independently, collaborate, and actively solve real-world problems relevant to the learning material. In this model, students are directly involved throughout the learning process, allowing them to build deep understanding and apply mathematical concepts in a contextual manner.

4. CONCLUSION

The conclusion drawn from the study is that there is a difference in mathematical literacy skills between students who received the Contextual Teaching and Learning model and students who received the Problem-Based Learning model in class VIII at a school in Garut Regency, on the topic of Systems of Linear Equations in Two Variables (SPLDV). The quality of improvement in mathematical literacy skills in the Contextual Teaching and Learning class showed a moderate quality, and the quality of improvement in mathematical literacy skills in the Problem-Based Learning class also showed a medium quality.

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