The Effectiveness of Comic Assisted Problem Based Learning Model on Numeracy Literacy Skills of Eighth Grade Students

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Abstract: Based on the initial test, the students' numeracy literacy ability is still relatively low. A learning model and media are needed that can familiarize students to solve problems in everyday contexts. The study aims to analyze the completeness of the numeracy literacy ability of students who are given the comic-assisted PBL learning model and students who are given the direct learning model, as well as analyze the effectiveness of the comic-assisted Problem Based Learning model on the numeracy literacy ability of grade VIII students. The research method is quantitative research with a nonequivalent posttest control group design. The sample in this study is two classes, namely as a control class and an experimental class. The data collection technique uses tests, interviews, observations, and questionnaires. The data analysis techniques used are z-test analysis and independent sample t-test. The results of the posttest of numeracy literacy skills in the experimental class and the control class were obtained $t_{value} = 2,95 > t_{tabel} = 1,68$ which shows that H_0 rejected and H_1 accepted. Conclusion of this study shows that the comic-assisted Problem Based Learning model is more effective on numeracy literacy skills compared to the direct learning model.

Keywords: comics; effectiveness; numeracy literacy; problem based learning.

INTRODUCTION

Literacy is an inseparable part of human life. Simply put, literacy can be defined as the ability to read and write. According to the World Economic Forum agreement in 2015, six fundamental literacy skills must be mastered by countries worldwide in the 21st century. One of these six fundamental literacy skills is numeracy literacy. Numeracy literacy refers to the ability to acquire, define, use, and communicate basic mathematical principles and concepts to solve problems in daily life (Fianto, 2018).

In 2023, the Organization for Economic Cooperation and Development (OECD) released the results of the Programme for International Student Assessment (PISA). Indonesia experienced a five-rank improvement in numeracy literacy and mathematics skills. However, Indonesia's score dropped by 13 points compared to the 2018 PISA results. Additionally, no Indonesian students reached Level 5 or Level 6 in mathematics and numeracy literacy. This indicates that students' proficiency in mathematics and numeracy literacy remains relatively low. To address this issue, according to (Ibrahim et al., 2017), the Ministry of Education and Culture (Kemendikbud) took action in 2016 by launching the Gerakan Literasi Nasional (GLN), one of which is the Gerakan Literasi Sekolah (GLS). GLS is a program designed to foster a literacy culture, including reading and writing literacy, numeracy, science, digital, financial, cultural, and civic literacy within the school environment. Numeracy literacy is the ability to apply fundamental knowledge, principles, and mathematical processes in everyday contexts (Herawati et al., 2019).

Based on the observations conducted, it was found that mathematics teachers have implemented the Problem Based Learning (PBL) model; however, challenges remain in its application. Teachers primarily use student worksheets (LKS) and government-issued textbooks as learning references. During face-to-face learning, teachers have yet to incorporate engaging instructional media effectively. The school has provided literacy and numeracy practice questions, but their implementation has been inconsistent. Additionally, a preliminary test was conducted to assess students' numeracy literacy skills. The results

showed that the average numeracy literacy score was 42.62, which is considered low according to (Putri, Utomo, & Zukhrufurrohmah, 2021). Therefore, this study develops a comic-assisted Problem Based Learning to enhance students' numeracy literacy skills.

Numeracy literacy is closely related to the ability to understand and solve problems. One of the learning models related to problem-solving is the Problem Based Learning model. According to (Rusman, 2018), Problem Based Learning is a learning approach in which students are presented with a problem and are then encouraged to solve it using their own knowledge and skills, develop the problem further, and cultivate critical thinking and problem-solving skills (Syamsidah & Suryani, 2018). The advantage of the Problem Based Learning model is that learning becomes more meaningful because students engage in the learning process directly, allowing them to explore their abilities, and enhancing their communication skills to collaboratively find solutions to problems within their groups effectively.

The considerations in this study include the fact that Problem Based Learning (PBL) assisted by the Cabri 3D V2 software has been shown to improve students' numeracy literacy skills (Widiastuti & Kurniasih, 2021). The difference from this study lies in the learning media used, which is comics. Additionally, research conducted by (Rahmah, Irianto, & Rachmadtullah, 2023) also demonstrated an improvement in numeracy literacy skills through the implementation of the PBL model. The distinction from this study is the incorporation of comics as a learning medium in the learning process. Furthermore, the study by (Shomad & Rahayu, 2020) stated that comic-based learning media can enhance students' learning motivation and academic performance. The difference from this study lies in the cognitive abilities measured. While (Shomad & Rahayu, 2020) focused on measuring students' motivation and learning outcomes, this study specifically examines numeracy literacy skills.

The implementation of the Problem Based Learning (PBL) model will be combined with mathematics comics as a learning medium. Students will be grouped and tasked with solving contextual problems related to statistical topics presented in the comics. Comics serve as a medium for delivering information through storytelling visuals (Putri, Hidayati, & Febriana, 2023). The use of comics in mathematics learning can enhance students' interest, engagement, and motivation to read and understand the mathematical concepts being taught.

The application of the PBL learning model will be combined with mathematical comic media. Students will be asked to group and solve contextual problems related to statistical material that will be presented in the comic. Comics are a medium used in presenting information in the form of images that tell a story (Putri, Hidayati, & Febriana. 2023). The use of comics in mathematics learning can increase interest, interest, and can motivate students to read and study the mathematics material taught.

Based on the description above, this study aims to analyze the attainment of students' numeracy literacy skills when taught using the comic-assisted Problem Based Learning (PBL) model, examine the attainment of numeracy literacy skills in students taught using direct instruction, and evaluate the effectiveness of the comic-assisted Problem-Based Learning (PBL) model compared to direct instruction in enhancing the numeracy literacy skills of eighth-grade students.

METHODS

The type of research used is quantitative research with a quasi-experimental design, specifically the nonequivalent posttest control group design. The population in this study consists of all eighth-grade students at SMP Islam Sunan Giri, with the experimental class being Class VIII C (24 students) and the control class being Class VIII A (24 students). The sampling technique used is cluster random sampling.

The data collection techniques used in this study include tests, observations, interviews, and questionnaires. Observations were conducted before the research process to assess the initial condition of students, while questionnaires were used for test instrument validation. The test instrument consisted of five open-ended questions, designed based on numeracy literacy skill indicators. The data analysis techniques included validity analysis, reliability analysis, difficulty level analysis, and discriminant analysis. Subsequently, prerequisite tests were conducted, including normality and homogeneity tests. Hypothesis testing was performed using the z-test and the independent sample t-test..

RESULTS AND DISCUSSION

The research process began with field observations and interviews to assess students' initial numeracy literacy skills. The results of the observations revealed that teachers primarily relied on textbooks and student worksheets (LKS) due to the lack of adequate teaching tools. Students were not actively engaged during the learning process, showing minimal participation in asking questions or responding to the teacher's prompts. Many students appeared bored due to the teacher-centered learning model. Next, interviews were conducted with the mathematics teacher, revealing that the teacher implemented Problem-Based Learning (PBL) and cooperative learning models. However, several challenges arose in practice, such as the extended time required and the less conducive classroom environment, leading to more frequent use of direct instruction. The teacher's use of learning media was limited to PowerPoint presentations and Kahoot, which was only utilized during online learning. Since the transition to in-person learning, the teacher had not incorporated any learning media to support the teaching process.

The instrument used to measure students' numeracy literacy skills consists of open-ended questions designed according to numeracy literacy indicators. The numeracy literacy test questions were piloted before being used in the study. Each test item incorporates the three numeracy literacy indicators adapted from (Han et al., 2017), which include (1) the ability to use symbols related to basic mathematics, where students can utilize various mathematical symbols, operations, strategies, methods, and basic mathematical rules to solve problems; (2) the ability to analyze information in questions, which measures students' ability to extract and analyze information presented in the form of text, charts, tables, diagrams, or other formats. Additionally, students should be able to present information in the form of tables, diagrams, or other representations; (3) the ability to interpret analysis results to predict and make decisions, which refers to students' ability to use their understanding of problem analysis results to predict solutions, evaluate the analysis, and consider effective solutions before determining the final resolution of a problem.. The results of validity analysis, reliability analysis, discriminant analysis, and difficulty level analysis are summarized in Table 1.

Table 1. Results of Analysis of Numeracy Literacy Questions

Item No.	Validity	Reliability	Difficulty Level	Differentiation	Conclusion
1	Valid		Keep	Enough	Used
2	Valid		Keep	Good	Used
3	Valid	Reliable	Keep	Good	Used
4	Valid		Keep	Good	Used
5	Valid		Keep	Good	Used

Based on the results in Table 1, the five tested questions can be used in the study. This analysis explains that all five questions contain the three numeracy literacy indicators that

have been outlined. After the test questions were trialed, treatments were applied to Class VIII A as the control class and Class VIII C as the experimental class. The control class used a direct learning model, while the experimental class used a comic assisted Problem Based Learning (PBL) model. Subsequently, a posttest was conducted to assess students' numeracy literacy skills. The post-test results for the experimental and control classes can be seen in Table 2.

Table 2. Posttest Data for Numeracy Literacy Ability

Class	x_{max}	x_{min}	$\bar{x}$	Standard Deviation	Variance
Experiment	100.00	64.00	81.39	9.6503	93.1295
Control	89.33	42.67	73.63	11.5064	132.356

Based on Table 2, the average score of the posttest results for numeracy literacy skills in the experimental class was 7.76 points higher than in the control class. The prerequisite test result for the numeracy literacy test are as follows. The results of the normality test on the posttest data of the experimental class were obtained $L_{value} = 0.121192 \leq L_{tabel} = 0.1766$. Meanwhile, in the control class, the results were obtained $L_{value} = 0.145554 \leq L_{tabel} = 0.1766$ so H_0 accepted. So that both the data from the experimental class and the control class are normally distributed. Meanwhile, the results of the homogeneity test on the posttest data of numeracy literacy ability were obtained $F_{value} = 1.788165 < F_{tabel} = 1.98$, so that the data variants of each group are the same or homogeneous. The results of the prerequisite test showed that the posttest data of the experimental class and the control class were normally distributed and the data variants were homogeneous. So that parametric statistical tests can be used for hypothesis testing.

The first hypothesis test was conducted to analyze the proficiency of students' numeracy literacy skills after being taught using the comic-assisted Problem Based Learning (PBL) model. The data analysis process utilized the z-test with a proficiency criterion of 75%. The results of the numeracy literacy proficiency analysis can be seen in Table 3.

Table 3. Hypothesis Test 1

Class	$\sum$Proficiency	N	z_{value}	z_{tabel}	Information
Experiments	20	24	0.942809	1.64	Accepted

The test criteria used are $z_{value} \leq -z_{tabel}$ so H_0 rejected. Based on Table 3, the calculation results were obtained $Z_{value} = 0.942809 > -z_{tabel} = -1.64$ so H_0 accepted. This indicates that students' numeracy literacy skills using the comic-assisted Problem Based Learning (PBL) model have met the proficiency criteria. Next, the second hypothesis test was conducted to analyze the proficiency of the control class, where the direct learning model was used. The data analysis process utilized the z-test with a proficiency criterion of 75%. The results of the numeracy literacy proficiency analysis can be seen in Table 4.

Table 4. Hypothesis Test 2

Class	$\sum$Proficiency	N	z_{value}	z_{tabel}	Information
Control	14	24	-1.88562	-1.64	Rejected

The testing criterion used was $z_{value} \leq -z_{tabel}$ so H_0 rejected. Based on Table 4, the calculation results were obtained $z_{value} = -1.88562 < -z_{tabel} = -1.64$ so H_0 is rejected. This indicates that students' numeracy literacy skills using the direct learning

model did not meet the proficiency criteria. Next, the third hypothesis test was conducted to analyze the effectiveness of the comic assisted Problem Based Learning model on numeracy literacy skills compared to the direct learning model. This test was performed using parametric statistical analysis with an independent sample t-test.

Table 5. Hypothesis Test 3

Class	$\overline{x}_i$	S_i	t_{value}	t_{tabel}	**Information**
Experiment	72.33	12.90469	2.753115	1.68	Rejected
control	81.39	9.650363			

Based on Table 5, the results of the calculation of the independent sample t-test show that $t_{value} = 2.753115 > t_{tabel} = 1.68$ meaning H_0 is rejected and H_1 is accepted. This indicates that, based on the independent sample t-test, the comic assisted Problem Based Learning (PBL) model is more effective than the direct learning model in improving numeracy literacy skills.

In the experimental class, four students did not achieve mastery learning out of a total of 24 students. This supports Hypothesis 1, where the experimental class, taught using the comic assisted Problem-Based Learning (PBL) model, achieved a mastery level of 83.33% in numeracy literacy skills, which is categorized as high according to (Astuti, Bayu, & Aspini, 2021). This finding aligns with (Rahmah et al., 2023), who stated that the PBL model positively influences students' numeracy literacy skills. This is because PBL encourages students to be more active in the learning process and maximizes their critical thinking skills to solve problems provided by the teacher. Similarly, (Abidah et al., 2021) emphasized that the PBL model helps students actively engage in the learning process by requiring them to think, reason, communicate, search for, and process data, ultimately leading to better conclusions.

The learning syntax using the Problem Based Learning model used in this study is adapted from (Sanjaya, 2020), namely, (1) orienting students to the problems; (2) organizing students in the research process, either independently or in groups; (3) assisting students in the investigation process, either independently or in groups; (4) developing and presenting the results of the investigation; (5) analyzing and evaluating the problem-solving process in the investigation. The PBL learning model places problems as the main focus in the learning process (Anwar & Jurotun, 2019). Through the PBL learning model, students learn to think critically, acquire concepts and knowledge from the problem-solving process, and enhance students' problem-solving skills.

Additionally, the use of comics increases students' interest in reading, allowing them to understand problem in a sequential manner. Through the use of visual media such as comics in learning, teachers can enhance students' reading interest and facilitate their understanding of the material being studied (Syahmita, Rezeki, & Ariawan, 2018). Belong is the comic used as a learning medium for mathematics on the topic of mean (average), as shown in Figure 1.
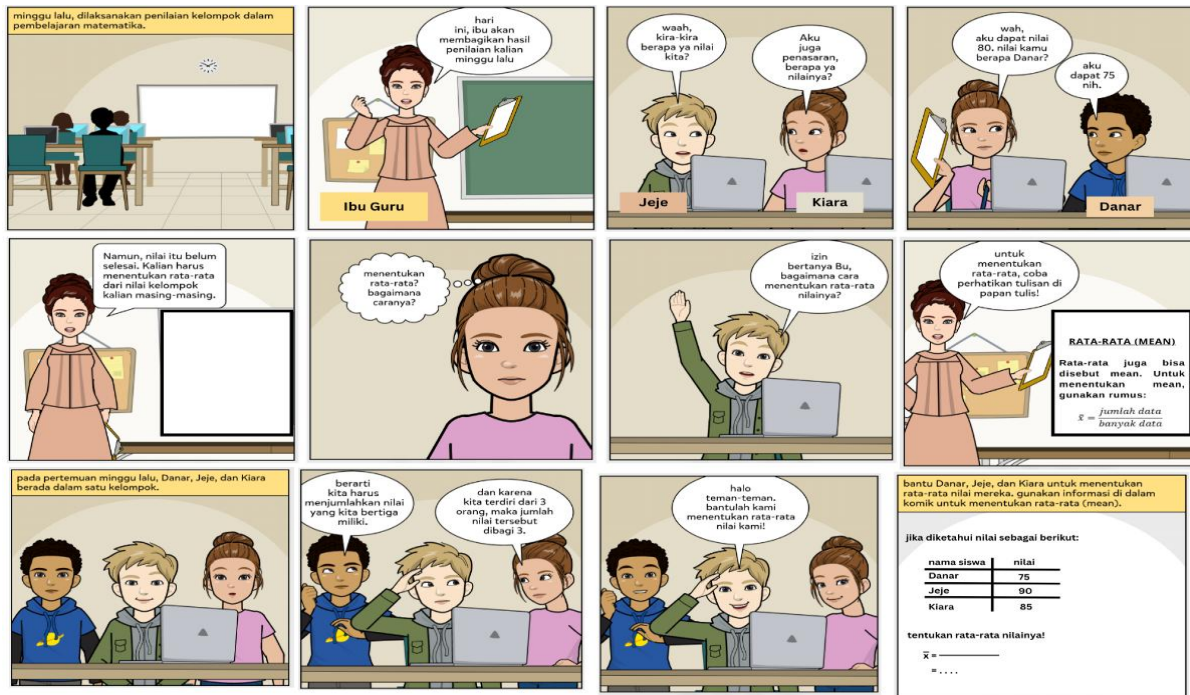
Figure 1. Comic Material Mean (Average)

The comic used in this study is a comic strip consisting of only 1-5 pages. The learning process within the comic follows the syntax of the Problem-Based Learning (PBL) model, which involves orienting students to a contextual problem. In this comic example, students are first asked to understand the problem being discussed. Then, they are required to solve the contextual problem presented using the comic, textbooks, and other learning resources. The comic is provided to each group in the experimental class, with each group consisting of 4-5 students.

The percentage of learning achievement through the implementation of the direct instruction model was less than 75%, with an average score of 72.33. This was due to the direct instruction model's emphasis on teacher-centered learning. Based on observations during the learning activities, students were not actively responding to the stimuli provided by the teacher. Additionally, they lacked confidence in expressing their opinions or responding to the teacher's prompts. As a result, students were less engaged during the learning process. This finding supports Hypothesis 2, which states that the control class did not achieve learning completion.

The results showed that the average posttest score in the experimental class was higher than in the control class. This finding is supported by the research of (Widiastuti & Kurniasih, 2021), which states that the Problem-Based Learning (PBL) model, when supported by instructional media, can enhance numeracy literacy skills. The significant difference in students' numeracy literacy skills was due to the higher level of engagement among students in the experimental class during learning activities. The PBL model, supported by comics, encourages students to think more actively, understand the learning material better, and increases their interest in reading and comprehending narratives in a structured and thorough manner.

CONCLUSION

The conclusion of this study is that students' numeracy literacy skills in learning activities using the comic-Assisted Problem-Based Learning model achieved learning completion, whereas students who used the direct instruction model did not reach completion.

Additionally, the Comic Assisted Problem Based Learning model was more effective than direct instruction in enhancing the numeracy literacy skills of VIII grade students. The Comic Assisted Problem Based Learning (PBL) model can serve as an alternative approach to improving students' numeracy literacy skills in statistical topics. The concepts in PBL using comics can also be applied to other subjects, considering the characteristics of the material being taught. Mathematical comics can be further developed with more engaging storylines and better-structured narratives. Furthermore, incorporating numeracy literacy-based exercises in learning activities is essential to help students become accustomed to solving contextual problems related to real-life situations in the form of numeracy literacy questions.

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