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Problem Based Learning: A Model in Geometry Learning to Measure Students' Mathematical Literacy and Self-Efficacy

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Abstract. Mathematical literacy is a necessary ability in the 21st century. Mathematical literacy plays a role in improving problem solving abilities. Mathematical literacy skills are needed to support a golden generation that is competitive in welcoming the development of science and technology. Besides that, self-efficacy is very necessary in learning mathematics. Self-efficacy plays a role in improving problem solving abilities. In fact, students' mathematical literacy skills and self-efficacy are still relatively low. Students have not been able to solve mathematical problems in the form of geometric problems. Students' weaknesses are caused by students' lack of training in solving problems outside of the habits taught, and the learning implemented has not trained students in developing mathematical literacy skills. Students' self-confidence in their abilities is less well formed and developed. So the aim of the research is to determine students' mathematical literacy abilities and self-efficacy by using problem learning models and conventional learning. This type of research is quantitative research using a quasi-experimental method with a nonequivalent control group design in class VII of one of the State Middle Schools in Serang Banten. Samples were obtained using purposive sampling technique. Data collection techniques used mathematical literacy ability tests and self-efficacy questionnaires. Data were analyzed using the difference between two means test with the t-test. The results showed that the mathematical literacy skills and self-efficacy of experimental class students were better than those in the control class. It was concluded that the mathematical literacy skills and self-efficacy of students who used the problem-based learning model were better than conventional learning.

INTRODUCTION

Mathematical literacy is an ability needed by students in facing learning developments in the 21st century. 21st century skills require students to be skilled in carrying out problem solving activities. Problem solving activities are part of the concept of mathematical literacy.Mathematical literacy is the ability to pose, formulate, and solve mathematical problems in a simple and well-understood way(Baiduri, 2019). Mathematical literacy is an individual's ability to formulate, apply and interpret mathematics in various contexts(Pratama et al., 2022). Students' mathematical literacy abilities are not only in the aspect of numeracy skills but also the ability to think logically and critically in solving problems(Lindawati, 2018).Mathematical literacy requires students to communicate and explain phenomena in everyday life using mathematical concepts(Habibi & Suparman, 2020). Mathematical literacy skills are the ability to recognize and understand the role of mathematics, solve mathematical problems in various contexts, interpret mathematical assessments, and apply mathematics rationally(Afriyanti et al., 2018). Mathematical literacy skills will support students' skills in solving mathematical problems logically using mathematical rules.

Mathematical literacy is important to develop in learning. Mathematical literacy requires students to be actively involved in everyday problem phenomena that are structured based on various mathematical contexts. This aims to train students in solving problems so that they can be applied to solving real problems faced in everyday life. This process can be done by means of mathematization, mathematization is the process of bringing the context of everyday problems into a mathematical model so that it can be solved well.Mathematization is the process of modeling a phenomenon mathematically (Agustianti Fuad & Zulkarnaen, 2022). This mathematization process consists of horizontal and vertical mathematization.Horizontal mathematization is the process of modeling everyday

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life into mathematical sentences, by finding regularities, relationships and structures towards mathematical models through schematization and visualization, vertical mathematization is a form of completing the mathematical model(Saadah et al., 2022). These two mathematizations are needed in solving mathematical literacy problems.

In Indonesia, students' mathematical literacy skills are still low. Based on several research results, it is said that Mathematical literacy achievement in Indonesia is still low, especially algebra material in PISA which contains Change and Relationship content (Yuliyani & Setyaningsih, 2022).Students' mathematical literacy in Indonesia is still considered low, based on the results of several surveys conducted by the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA).(Yuliana & Fembriani, 2022). The development of students' mathematical literacy in Indonesia refers to the results of the PISA test which has not shown significant results placing Indonesia's position at the top level(Qadry et al., 2022). This low mathematics literacy result also occurs in one of the State Middle Schools in Serang City. This low level of mathematical literacy can be seen based on the results of the initial test of students' mathematical literacy abilities. Students' inability to work on questions related to mathematical literacy, especially when carrying out the horizontal mathematization process. Mathematical literacy problems are also influenced by students' lack of confidence in their abilities, known as self-efficacy.

Self-efficacy is an individual's belief in their ability to complete or solve a given task or the actions that must be taken to obtain certain results. Self-efficacy is a feeling of confidence in one's ability to achieve certain goals(Ferdyansyah et al., 2020). Self-efficacy is a person's belief about his or her capability to influence desired outcomes(Darta, 2021). Mathematics self-efficacy is a self-concept related to an individual's belief in his or her ability to perform or complete a mathematical task or problem(Pardimin, 2018). Self-efficacy has three dimensions consisting of magnitude, generality and strength dimensions. These three dimensions are used to measure student self-efficacy in learning.

Student self-efficacy is important to develop in the mathematics learning process. This is because the higher the student's self-efficacy, the more it affects the quality of learning outcomes. Several research results say thatSelf-efficacy has a significant effect on junior high school students' mathematical communication skills(Hendriana & Kadarisma, 2019). Based on path analysis, there is an influence of self-efficacy on students' mathematical reasoning(Gustia Putri Lestari et al., 2022). Self-efficacy has a significant effect on students' mathematical problem solving abilities(Agustina & Munandar, 2022). With self-efficacy, it can improve the quality of learning outcomes. Self-efficacy greatly influences mathematical literacy, whether high, medium or low self-efficacy(Atho'illah et al., 2022). However, in the learning process, student self-efficacy is still low(State et al., 2023).

Problems of mathematical literacy and student self-efficacy can be overcome by using learning models. A learning model that can be used as an alternative is a problem-based learning model. The problem-based learning model is a learning model that places greater emphasis on problem solving to determine the development of students' thinking abilities and meaningful learning(Faqiroh, 2020).Providing problems related to real life in problem-based learning makes students more active in learning, because they can find connections between the learning material and everyday life.(Saputri, 2019). Based on the problems of mathematical literacy and student self-efficacy, the aim of this research was to determine students' mathematical literacy abilities and self-efficacy using problem learning and conventional learning models.

METHODOLOGY

This research is quantitative research using experimental methods. The experiment was carried out in two classes, namely the experimental class and the control class. The population used was all class VII students of one of the State Middle Schools in Serang City which consisted of 7 classes. Sampling was carried out randomly *purposive sampling*. Data collection techniques were carried out by means of mathematical literacy ability tests and questionnaires to reveal *self-efficacy* student. The instruments used were literacy ability test question sheets and questionnaires *self-efficacy* which has carried out content and empirical validation as well as instrument reliability testing. The mathematical literacy ability test uses 5 essay questions and 30 questionnaire statement items*self-efficacy*which is valid and reliable. Data analysis was carried out by testing the hypothesis using the t-test before prerequisite tests were carried out, namely the normality test and homogeneity test. All data testing processes are assisted *statistical software.*

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RESULTS AND DISCUSSION

Research result

The results of research conducted on students' mathematical literacy abilities are as follows.

Table 1. Descriptive Score Analysis Resultsstudents' mathematical literacy abilities

	N	Mean	Standard Deviation	Minimum	Maximum
Experiment	36	72.07	15,566	44	100
Control	36	38.34	14,371	21	78

Based on table 1 above, it can be concluded that there is an average difference between the experimental class and the control class. This also happens with standard deviation, minimum and maximum values. This can prove that there are differences in the results of students' mathematical literacy abilities in the two classes. To answer the research hypothesis, a prerequisite test was carried out first, followed by a t-test. The first prerequisite test is the normality test with the following test results.

Table 2. Normality Test Results for Mathematical Literacy Ability Scores

Class	*Kolmogorov Smirnov Sig.*
Experiment	0.148
Control	0.095

Based on table 2 above, it can be seen that the significance value is more than 0.05, indicating that the two class data are normally distributed. The next step is to carry out a homogeneity test, which is the second prerequisite test. The homogeneity test results are as follows.

Table 3. Score Homogeneity Test Results Mathematical Literacy Ability

Class	*Sig. (Based on Mean)*	Information
Experiment Control	0.413	Homogeneous

Based on table 3 above, it can be seen that the significance value (sig.) based on mean is more than 0.05, this shows that the two sample data have the same variance. After obtaining data from both classes that are normally distributed and have the same variance, the t test is carried out to draw hypothetical conclusions. Testing was carried out by testing two averages using an independent sample t-test with the following results.

Table 4. Independent Sample T-test Results for Mathematical Literacy Ability Scores

Class	*Sig. (2-tailed)*	Information
Experiment Control	0,000	H_0rejected

Based on the Independent Sample t-testin table 4 above, a significance value of 0.000 is obtained, this shows that the significance value is smaller than 0.005, meaning that the null hypothesis of the research is rejected, while the alternative hypothesis is accepted, namely that students' mathematical literacy abilities using the problem-based learning model are better than conventional learning.

The results of research conducted on student self-efficacy are as follows.

Table 5. Results of Descriptive Analysis of Self-efficacy Scoresstudent

	N	Mean	Standard Deviation	Minimum	Maximum
Experiment	36	125.61	15,146	97	148
Control	36	105.31	11,471	71	135

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Based on table 5 above, it can be concluded that there is an average difference between the experimental class and the control class. This also happens with standard deviation, minimum and maximum values. This can prove that there are differences in student self-efficacy results in the two classes. To answer the research hypothesis, a prerequisite test was carried out first, followed by a t-test. The first prerequisite test is the normality test with the following test results.

Table 6. Self-Efficacy Score Normality Test Results

Class	*Kolmogorov Smirnov Sig.*
Experiment	0.121
Control	0.087

Based on table 6 above, it can be seen that the significance value is more than 0.05, indicating that the two class data are normally distributed. The next step is to carry out a homogeneity test, which is the second prerequisite test. The homogeneity test results are as follows.

Table 7. Self-Efficacy Score Homogeneity Test Results

Class	*Sig. (Based on Mean)*	Information
Experiment Control	0.314	Homogeneous

Based on table 7 above, it can be seen that the significance value (sig.) based on mean is more than 0.05, this shows that the two sample data have the same variance. After obtaining data from both classes that are normally distributed and have the same variance, the t test is carried out to draw hypothetical conclusions. Testing was carried out by testing two averages using an independent sample t-test with the following results.

Table 8. Independent Sample T-test Results Self-Efficacy Score

Class	*Sig. (2-tailed)*	Information
Experiment Control	0,000	H_0rejected

Based on the Independent Sample t-testin table 8 above, a significance value of 0.000 is obtained. This shows that the significance value is smaller than 0.005, meaning that the research null hypothesis is rejected, while the alternative hypothesis is accepted, namely that student self-efficacy using the problem-based learning model is better than conventional learning.

Discussion

Based onthe results of hypothesis testing show that students' mathematical literacy skills using the problem-based learning model are better than conventional learning. Problem-based learning emphasizes problem-oriented learning that must be solved or completed by students. Solving these problems is carried out in groups so that there is a process of sharing information between students. This problem-based learning requires students to collect information, process information to solve problems and draw conclusions. With scientific processes or activities, students increasingly improve their way of thinking and reasoning in solving problems, especially students' mathematical literacy problems. This scientific activity directly shapes students' mathematical literacy abilities. This is in line with research results which state that problem-based learning with the RME approach assisted by schoolology is higher than increasing students' mathematical literacy skills with conventional learning at SMP Negeri 2 Purwokerto(Nolaputra et al., 2018). The use of the problem-based learning model influences the mathematical literacy abilities and mathematics self-efficacy of class VII junior high school students(Rismayanti & Wahyuni, 2022).Mathematical Literacy abilities in the experimental class using a problem-based learning model are better than the control class with conventional learning(Supriatna, 2017).

The mathematical literacy abilities of students with conventional learning have not developed well. This is because conventional learning does not facilitate students to solve problems in groups so that students are not actively involved in learning. The lack of student activity in solving students' mathematical literacy problems, which tends to be done by the teacher, makes students less trained and challenged in the mathematical literacy questions given. Students tend to only be observers of learning activities, as a result, if they are given questions about

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mathematical literacy, students have difficulty solving these problems, resulting in low mathematical literacy abilities.

Based on testing the hypothesis that student self-efficacy using the problem-based learning model is better than conventional learning, it shows that students' self-confidence in their abilities using the problem-based learning model is getting better. This is because problem-based learning increases information sharing activities between students in groups. By solving problems in groups, it grows students' self-confidence to express opinions and discuss with each other. So that students' self-confidence in their abilities grows and develops. This is in line with research results which state that the problem-based learning model can be a solution in developing students' mathematical problem solving abilities and self-efficacy in mathematics learning.(Irfan et al., 2022). Mathematics self-efficacy for learning using PBL is better than students learning using an expository approach(Sariningsih & Purwasih, 2017). The self-efficacy of students who use the Problem Based Learning learning model in mathematics learning is included in the good category(Firmansyah et al., 2020). The increase in student self-efficacy in linear programming courses with problem-based learning is better than students with conventional learning in terms of overall student initial abilities (KAM).(Octaria & Puspasari, 2018).

Conventional learning does not facilitate the development of student self-efficacy, this is because learning tends to be dominated by teachers or learning is still teacher-centered. Conventional learning is still teacher-centered so students are still less active in developing and growing their self-efficacy. Self-efficacy is an important thing to develop in the learning process. Using the right learning model will have an effect on increasing students' self-efficacy in learning mathematics. Student self-efficacy can develop through the stages or steps in the learning model.

CONCLUSION

Based on the results and discussion of the research, it was concluded that the use of a problem-based learning model is better than conventional learning from the aspects of students' mathematical literacy abilities and self-efficacy. Students' mathematical literacy abilities by using the problem-based learning model obtain better results, students are trained to solve mathematical literacy problems using the stages of problem-based learning. With the advantages of problem-based learning, students become increasingly confident in their abilities in solving any given problem.

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