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The Influence of Problem Based Learning Model with Scientific Approach on Junior High School Students' Mathematical Literacy Skills

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ABSTRACT

Research purposes This is for now the influence of the Problem Based Learning learning model with approach scientific to ability literacy mathematics Junior High School Students Class VII Topic statistics. Types of research This is study quasi experiment with approach quantitative. Population in study This is all over student class VII of a junior high school in Depok, Sleman, Special Region of Yogyakarta. The method of taking sample use technique *cluster random sampling* with design *posttest only control group design Study* This use technique data collection in the form of test. Instrument test in study This used For measure ability literacy Mathematics , Research results show that there is influence of learning models *problem based learning* (PBL) with approach scientific to ability literacy mathematics student class VII on data diagram material , where obtained Sig, (2 tailed) 0.000 where with $\alpha = 0{,}05$then obtained Sig, (2 tailed) 0.000 < 0.05 then H_0rejected, where there is a difference in *the posttest results* literacy mathematics between class experiment with learning model treatment *problem based learning* with approach scientific and class control that uses learning conventional .

KEYWORDS: Mathematics Learning; Mathematical Literacy; Problem-based Learning; Scientific Approach

I. INTRODUCTION

The era of globalization is starting to develop today, development demands various aspects to renew themselves and follow the flow of developments, especially education. 21st century skills are now being demanded in the world of education which makes students now have to be more sensitive to the abilities they have. The 21st century skills in question are the ability to think critically, solve problems, metacognition, communicate, collaborate, creative innovation and literacy (Mardhiyah et.al., 2021).

Reflecting on the world of education today and its demands, the education process itself has also begun to develop with many research studies on how learning is carried out optimally by utilizing what is available now. Learning is the initial process for students to be introduced to important aspects of education that are not just receiving material alone but also other aspects. One of the subjects that is in the spotlight and is problematic is mathematics. Mathematics is one of the subjects taught from elementary school to college, wherever the level is, mathematics plays a fairly central role in the development of technology and science (Nahdi, 2019).

As a fairly central and important subject, mathematics has many branches and also challenges in learning it. Mathematics is widely known as an abstract subject that is difficult and hard to understand. This becomes a challenge in itself how mathematics is delivered. Nowadays, many learning models are developed that are oriented towards problem solving , with *problem solving* in mathematics it is expected that students are able to solve problems not only using formulas theoretically but also contextually. The learning model that is often used in the concept of *problem solving* is *Problem Based Learning* or PBL.

Problem Based Learning (PBL) is a learning model based on the principle of problems that are the beginning of new knowledge (Amiluddin & Sugiman, 2016). According to Levin (2001:1). According to Setyaningsih & Abadi (2018), *problem based learning* is a learning model that confronts students with complex problems and requires students to conduct investigations. According to Sofyan (2017) *problem based learning* is learning that begins learning with problem

solving where students must have new knowledge to solve the problem. It is said that *problem based learning* (PBL) is learning that begins with problems that require students to solve them based on their mathematical abilities.

Problem based learning is a learning model that begins with the submission of problems, questions, and puzzles so that students are required to solve them. PBL learning makes problems the beginning of learning, especially mathematics that requires abstraction, with PBL students not only memorize formulas but are taught how the formulas are obtained and derived. The reality is that the PBL learning model is still not optimally taught by teachers because it still requires comprehensive observation in mathematics classes. PBL in many situations can be one of the solutions to problems in learning mathematics, one of which is in a study by Setyaningsih and Abadi (2018) which states that PBL is effective for learning for algebra learning achievement, critical thinking and student anxiety. One of these studies states that PBL itself is effective in overcoming problems in learning mathematics as evidenced by the effectiveness of the model in terms of various aspects, both cognitive and affective. *Problem based learning* (PBL) according to Sofyan (2017:52) states the importance of PBL as follows, through PBL learning students are expected to be able to link their abilities outside of mathematics so that scientific integration can occur, students' abilities will continue to update their knowledge development, behavior as a " *life long learner* " can be achieved, becoming a balancing tool due to the rapid development of science. Any learning model must have steps or syntax in its implementation which are the characteristics of the learning model. The PBL model itself also has learning steps according to Sani (2014:143) are first, student orientation to the problem. Second, organizing students. Third, collecting information and data. Fourth, developing and presenting work results. Fifth, analyzing and evaluating the problem solving process

As the world of education develops, we often hear learning approaches juxtaposed with learning models. One approach that is trending in mathematics education research is the scientific approach. In general, the scientific approach is an approach that aims to activate students in constructing concepts, knowledge, laws or principles with a scientific approach (Muliyana & Jailani, 2023). The scientific approach in mathematics learning itself has many roles, because several mathematical concepts use a lot of abstraction so that an approach with scientific rules such as the scientific approach is more suitable for several concepts with the operational word finding. The steps of the scientific approach itself according to Musfiqon and Nurdyansyah (2015:52) are formulating questions, formulating backgrounds, formulating hypotheses, testing hypotheses, analyzing results. The scientific approach itself became a trend when the 2013 curriculum was implemented, but along with the development of the curriculum, even though the 2013 curriculum was gradually replaced by the Merdeka curriculum, the scientific approach is still widely used as one of the packaging materials to increase student activity in learning mathematics.

The use of PBL and Scientific itself is an implication of the demands of the 21st century, where developments in this century encourage students to have critical thinking skills, problem solving, communication, and collaboration (Juana et.al., 2023). Seeing these developments will have an impact on mathematics learning itself. In addition to talking about 21st century skills that are no less important are students' mathematical cognitive abilities, because this is the goal in mathematics learning, the problems that are a serious focus of the government in the Merdeka curriculum design are literacy and numeracy.

Numeracy ability itself is associated with abilities that existed before the term, namely mathematical literacy. Mathematical literacy is an important ability in learning mathematics because in this ability many other cognitive abilities are measured in learning mathematics. Before looking at mathematical literacy, the basic word of mathematical literacy itself is literacy, according to Hanum et al. (2020) literacy is a person's ability to receive and process information obtained and from that information it is then analyzed and related to contextual problems. Mathematical literacy itself is defined almost the same as literacy, namely Mathematical literacy is a person's ability to formulate, use and interpret mathematics in various contexts (Mansur, 2018).

Mathematical literacy itself is one of the surveys conducted by PISA (Program for International Student Assessment) every few years, seeing the survey PISA itself releases the rankings and scores achieved by each participating country in the PISA test, one of which is Indonesia. According to the results of the PISA 2022 release, Indonesia's score is still at level 1 with a score of 366, down compared to 2018 (OECD, 2022). This requires special attention to the mathematical abilities of Indonesian students so that it becomes a reason to carry out effective mathematics learning planning to overcome these various problems. The indicators of mathematical literacy according to the PISA Framework are formulating situations into mathematical language, namely students are able to state important information in the problem, then students are able to explain how to solve the problem and the concepts that will be used, students understand and explain the relationship between language, symbols and the context of the problem so that it can be presented mathematically. The second indicator is using mathematical concepts, facts, procedures, and reasoning , evaluating and communicating solutions to mathematical problems, namely students are able to design and apply strategies to find mathematical solutions, students are able to apply facts, rules, algorithms, and mathematical structures when looking for solutions, students are able to make

generalizations based on mathematical result procedures to find solutions. The third indicator is providing ideas and arguments based on information or solutions to mathematical problems where in this indicator students are able to interpret the reasons why the conclusions they obtain are in accordance with the context of the given problem.

Problems in learning mathematics are so complex and are no exception to its branches of science, one of which is statistics. Based on the mathematics curriculum in the Merdeka Phase D curriculum, one of the materials is data diagrams (Kemendikbudristek, 2022), where in this material students are taught and required to process raw data from contextual problems into mathematical language, from here the ability that students must have is mathematical literacy skills, because not only reading and collecting information from contextual problems but also processing it in the form of data and diagrams.

Based on the results of observations on students and mathematics teachers of class VII SMP Diponegoro Depok, it was stated that students' mathematical literacy skills in processing information were still inadequate so that improvements were needed with certain treatments. The PBL learning model in many studies has been very effective in learning mathematics oriented towards various abilities, in addition, the scientific approach is also often used to complement learning models to improve various abilities, so that in this learning practice we will see how the combination of PBL learning models and scientific approaches in learning mathematics and what will be seen affects students' mathematical literacy skills in statistical material on data and diagram topics.

II. RESEARCH METHOD

The era of globalization is starting to develop today, development demands various aspects to renew themselves and follow the flow of developments, especially education. 21st century skills are now being demanded in the world of education which makes students now have to be more sensitive to the abilities they have. The 21st century skills in question are the ability to think critically, solve problems, metacognition, communicate, collaborate, creative innovation and literacy (Mardhiyah et.al., 2021).

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III. RESULT & DISCUSSION

The practice of mathematics learning innovation was carried out at SMP Diponegoro Depok in classes VII C and VII F. The implementation of the practice of mathematics learning innovation was carried out from March 14 to April 03, 2024. The number of students in both classes was the same, 27 students. Two classes were chosen because this study used a *Posttest Only control group design* which required 2 sample classes. This practicum used class VII C as an experimental class which was given treatment using a *problem-based learning model* with a scientific approach, while class VII F was used as a control class with a conventional learning mode. The materials used were data and diagrams with details of collecting data, presenting data in the form of tables, bar charts, lines, and circles.

The first step in implementing innovation practices in mathematics learning is to design learning tools, namely teaching modules that are in accordance with the material to be taught according to the Learning Outcomes of Phase D of mathematics, namely data and diagrams, then for treatment starting from *problem-based learning model activities* with a scientific approach, namely by applying the syntax of the learning model in the learning steps, then a scientific approach to the presentation of the material and also detailed in the learning steps. Each class is held three times with treatment according to the type of class.

The second step is the implementation of learning with different treatments according to the type of class, learning steps using steps according to the teaching module and LKPD as learning media that are worked on in groups. After 3 meetings, *a posttest will be conducted* for both classes.

The third step is the mathematical literacy *posttest* , where the control class was carried out on Monday, March 25, 2024 in class VII F, then carried out in the experimental class on Wednesday, April 03, 2024 in class VII C. *The posttest* itself was compiled based on mathematical literacy indicators and learning objective indicators with 3 descriptive questions. The test used used instruments and scoring guidelines that had been prepared previously and tested in both classes. Before being applied, the teaching module and test instruments were validated by the mathematics teacher of SMP Diponegoro Depok.

The following is the descriptive data for all classes, both experimental and control.

Table 2 Descriptive statistics of control and experimental class data

Class	Number of Students	Min.	Max.	Mean	Std. Dev.
Control	27	40	80	60,852	12,847
Experiment	27	60	93	76,407	9,778

Based on table 2, it can be seen that the number of students in the control and experimental classes is the same, namely 27 students, so the comparison is more accurate. Three meetings of learning were carried out in each class and 1 meeting for the test, it was obtained that the minimum value of the control class, namely 40, was lower than the experimental class, namely 60. The maximum value of the control class with a value of 80 was lower than the experimental class with a value of 93. The average of the two classes can also be seen that there is a fairly clear difference, namely the average *posttest value* of the control class is lower than the *posttest value* of the experimental class where the average control class gets an average of 60.852 lower than the experimental class, namely 76.407. From these data, descriptively, the class with Scientific PBL treatment gets a higher value compared to the one that is not given Scientific PBL treatment and it can be interpreted that Scientific PBL has an influence but there needs to be an inferential test to prove this statement.

The test is continued with an inferential statistical test, but before entering the inferential test, there is an assumption test that needs to be met. The assumption test in this study is the normality test and the homogeneity test of the *post-test results* of the experimental class and the control class. This assumption test is used as a requirement to conduct an *independent t-test* as a parametric test. The normality test used in this study is the *Shapiro Wilk test* because the number of samples is less than 100 people. The normality test of this study uses the help of *SPSS Version 25 software* with a significant level $\alpha = 0{,}05$. The following are the results of the normality test of the experimental class and the control class.

Table 3. *Shapiro-Wilk* Normality Test

Class	Significance	Decision
Experimental Class	0.076	Normal
Control Class	0.129	Normal

Based on table 3, it can be seen that the significance of the experimental class is 0.076 and the control class is 0.129 in accordance with the normality requirements. Both classes have a significance value of more than 0.05 so that the data is normally distributed.

The next test is the homogeneity test. The homogeneity test used in this study is the *Levenne test* . The homogeneity test of this study uses the help of *SPSS Version 25 software* with a significant level $\alpha = 0{,}05$. The following are the results of the homogeneity test of the experimental class and the control class.

Table 4. Levenne's Homogeneity Test

Levenne Statistics	Experimental Class	Control Class	Sig.	Decision
1,564	1	52	0.217	Homogeneous

Based on table 4, the significance is 0.217 where 0.217>0.05 so that the *posttest results* of the experimental and control classes come from a homogeneous population. The requirements for the parametric hypothesis test are met, namely the data is normally distributed and homogeneous, so it can be continued for data analysis using *the Independent t test* . The following are the results of the independent sample t test with the help of *SPSS 25 software*.

Table 5. Independent Sample Test

Mathematics Literacy Test	F	Sig.	t	df	Sig. (2 tailed)
	1,564	0.217	5,006	52	0,000

Based on table 9, Sig, (2 tailed) 0.000 was obtained, where $\alpha = 0{,}05$Sig, (2 tailed) 0.000 < 0.05 $H_0$was obtained , so it was rejected, where there was a difference in the results of the mathematical literacy *posttest* between the experimental class with *the problem based learning model treatment* with a scientific approach and the control class using conventional learning.

This study aims to determine the effect of mathematics learning using a *problem-based learning model* with a scientific approach to improve students' mathematical literacy skills. This study was conducted at SMP Diponegoro Depok class VII C and Class VII F using a *problem-based learning model* with a scientific approach with 27 students in each class. The material used in the practice of mathematics learning innovation is statistical material, the main topic of data and diagrams, where learning outcomes are in accordance with the demands of phase D in the mathematics subject of the Merdeka curriculum. This practicum uses a *posttest only design* so that a control class and an experimental class are needed with the test given being a mathematical literacy ability test in the form of descriptive questions with a total of 3 questions that have been validated by the mathematics subject teacher.

Based on the data analysis results, the following will explain the results of the research that has been carried out, namely the results of the mathematical literacy test of experimental class students are better than the mathematical literacy of control class students. The average mathematical literacy score of the experimental class is 76.41 and the control class is 60.85. Data analysis with the t-test shows that there is a significant difference between the two classes. The influence of learning models and approaches The treatment of learning models in the experimental class with a *problem-based learning model* with a scientific approach shows that there is an influence on students' mathematical literacy abilities because the test results of the experimental class are better than the control class.

The results of this study are supported by the results of other studies, one of which is by Sari et.al. (2017) where the ability of the results of this study is the ability and improvement of students' mathematical literacy and their learning independence using the PBL model is better than students with conventional learning. Another study that supports this is by Agustin et.al. (2022) where in addition to concluding that the PBL learning model has an effect on mathematical literacy skills, the subject or material used is the topic of statistics. The results of the study by Hasmiwati and Widjajanti, DB (2020) stated that the combination of learning based on the theory of multiple intelligences and a scientific approach has the potential to improve students' mathematical literacy skills and also reinforces that the scientific approach has an influence on mathematical literacy skills. Research on the influence of scientific on mathematical literacy shows an increase in the average between the control and experimental classes. Several reinforcements from previous studies prove that the use of one treatment, either the PBL model or the scientific approach alone, has shown a significant influence on students' mathematical literacy skills, especially on statistics topics. With research on the combination of both, it is reinforced that the combination of the PBL learning model and the scientific approach can have a greater influence on students' mathematical literacy skills.

IV. CONCLUSION

Based on the results obtained then the conclusion from study This is there is influence of learning models *problem-based learning* (PBL) with approach scientific to ability literacy mathematics student class VII on data diagram material. This is obtained existence significant difference between class the experiment given treatment use influence of learning models *problem-based learning* (PBL) with approach scientific and class control with only use learning conventional. Class experiments higher than average ability literacy mathematics compared to class experiment.

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