Literature Study of the Influence of Problem-Based Learning Model on Students' Mathematical Reasoning Ability

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ABSTRACT

This scientific work is a study of literature that discusses the effect of the Problem-Based Learning learning model on students' mathematical reasoning abilities based on various information such as books, journals, articles, and other scientific works. Five journals are used as a source of theory in this study, so the data or theory used is relatively straightforward and accurate. The method used in this scientific work is library research. The source of information was obtained from a study of 5 selected journals about the effect of Problem-Based Learning models on students' mathematical reasoning abilities. From this study, data was obtained that learning using the problem-based learning model positively influenced students' mathematical reasoning abilities. Therefore, using the PBL learning model can be a solution and strategy for solving problems found in life. The PBL model can be an innovative and varied solution in implementing classroom learning to improve students' mathematical reasoning and learning outcomes.

Keywords: Study Literature, Problem Based Learning Model, Mathematical Reasoning Ability

INTRODUCTION

Mathematics is a compulsory science that students must learn. Mathematics is the mother of all sciences because all branches of science must apply mathematics to it. Mathematics is the science that underlies the development of modern technology as it is today and even progresses over time. The mindset of mathematics is used in developing science and technology in this era of globalization (Rhofiqah & Thaariq, 2019). Mathematics is taught from elementary to tertiary level, indicating that every student is expected to have mathematical abilities. The goal is to provide convenience and help solve daily problems. Mathematics comes from someone's thoughts, ideas, and reasoning, which is agreed upon by all parties (Kusumawardani et al., 2018). In addition, everyone needs to have mathematical abilities to keep up with the times, especially in this era of globalization (Yumiati & Noviyanti, 2017).

Mathematics is taught in schools to improve students' problem-solving, proof, communication, connection, representation, and reasoning abilities (NCTM, 2000).

Learning mathematics in schools is a form of education implemented by the government. Education is a process that humans must pass to gain learning experience and develop the abilities or potential within them. Education does not have to be at school; education can be obtained anywhere, whether in the community, family, or school. Through education it is expected to be able to create competent human resources and be able to support the progress of a country (Nababan, 2020).

Education development does not mean there are no obstacles or problems that arise. One of them is in the process of learning mathematics at school. Problems that occur in schools become an inhibiting factor in achieving learning objectives. Five abilities must be mastered by students, especially in learning mathematics, namely: 1) problem-solving, 2) reasoning and proof, 3) communication, 4) connections, and 5) representations (NCTM, 2000).

One of the competencies that students are expected to have is reasoning ability. Reasoning is critical in learning mathematics. The Ministry of National Education states that mathematics and reasoning are two things that are interconnected and cannot be separated, namely that mathematics is understood through reasoning. The reasoning is trained through learning mathematics (Jamilun & Suhar, 2016). Based on this statement, learning mathematics is a process to bring out students' reasoning abilities so that they can be trained and develop problem-solving skills within themselves. Therefore, the learning process that must be carried out must involve students, and two-way learning, namely students-teachers and teacher-students.

Several years ago, even this year, the government has enlivened the K13 curriculum; this year, it has even changed to the independent curriculum. However, this does not rule out that much of what is happening in the field only focuses on the teacher's teaching process or one-way learning. There are still many schools where the teachers actively dominate the class, but the students are passive, so knowledge is only obtained from the teacher. Learning that is only one way is not able to explore students' abilities and efforts to find their understanding so that they do not develop their potential and skills (Afifah et al., 2020).

Many problems occur in schools regarding mathematics learning. The facts on the ground are not as expected. This problem will disrupt the learning process. It triggers chaos, noise, complaints, and teacher confusion. The cause of the low ability of students in learning mathematics is that students are lacking in terms of observing, listening, and understanding, and it is difficult to make sense of a mathematical statement so that they can provide appropriate new conclusions (Khaesarani & Hasibuan, 2021).

Mathematical reasoning ability is an essential part of understanding mathematics, exploring ideas, finding solutions and using relevant mathematical sentences, and understanding that studying mathematics is meaningful and logical. One of the foundations of mathematics is reasoning (Vatillah et al., 2020). The ability to reason needs to be developed in students to avoid misconceptions and mistakes in thinking about mathematics and to change the concept of mathematics which is only formulas and numbers. Still, mathematics is a science full of meaning and value in everyday life. In addition to

misconceptions and thinking errors, it is also feared that students will make mathematics only a material that follows procedures and imitates examples without going deep into its meaning and meaning.

The reasoning is the process of thinking from something known by connecting with the facts to a conclusion. The reasoning is a thinking activity to make new statements following the occurring points (Keraf, 1982). Reasoning is an activity of higher-order thinking processes to develop what knowledge one has following facts and mathematical principles. In practice, it requires problem-solving skills, the ability to simplify complex matters into correct and acceptable conclusions, and the ability to connect implications and ideas. Ideas into mathematical statements (Rhofiqah & Thaariq, 2019).

If students' mathematical reasoning increases, it will not only lead to an increase in students' understanding of mathematics but also lead to a rise in the application of mathematical knowledge in solving problems in real life (Mukuka et al., 2021). Mathematical reasoning has a role in solving mathematical problems. When students are involved in mathematical problem-solving activities, they indirectly build and grow their reasoning abilities (Elvis Napitupulu et al., 2016).

Reasoning ability is an ability that must be possessed by students so that students' problem-solving abilities increase. Problem-solving skills can be trained in elementary school children and for a continuous period. One solution that can be used to address these needs is the use of learning models (Syamsu, 2018). Problem-solving is an essential part of the mathematics curriculum because students will gain experience in using their knowledge and skills to solve problems.

There are two types of reasoning: inductive reasoning, also called induction, and deductive reasoning, which is called deduction. Inductive reasoning is based on specific or limited cases, problems, or questions to draw conclusions. Meanwhile, deductive reasoning is reasoning from general principles, knowledge, and experiences that are still broad or general and then drawing conclusions that are more specific or more directed at something (Sumarni & Sumarmo, 2016). Reasoning ability is a powerful enough strategy to improve student learning outcomes. Therefore, students' low reasoning abilities will result in difficulties in understanding mathematical concepts. Even though mathematical reasoning is an important aspect, there are still many students who are weak in terms of mathematical reasoning. Weaknesses in students' mathematical reasoning abilities can be seen from the PISA survey quoted from Research and Development; the average student achievement score in Indonesia has not yet reached the international average score. (Afif & Suyitno, 2016).

One of the efforts that can be made to optimize learning outcomes in schools is that teachers need to apply learning strategies that are appropriate and appropriate for students. The teacher must carry out learning strategies to achieve learning objectives effectively and efficiently (Saeful, 2019). Indicators of learning success include the teacher playing a considerable role in determining the most appropriate strategy to optimize the ability of each learner to achieve learning goals. PBL is a learning model with an excellent opportunity to develop thinking skills such as reasoning, communication, and connections

in solving problems (Rusman, 2011), so the PBL learning model can be the teacher's choice in choosing a learning model.

The problem-based learning model is a problem-based learning model. Learning models emphasize students construct concepts based on situations, build rules and learn to find something to solve the issues and find solutions to a given problem. Learning with PBL will be successful if students' understanding of the material increases and they are accustomed to finding solutions and constructing concepts for the shared issues (Vatillah et al., 2020). Through Problem-Based Learning (PBL), the teacher will present problems to students who are required to think at a higher level by using and honing their mathematical reasoning abilities. The steps for Problem-Based Learning based on the Ministry of Education and Culture (2014) are:

1. Students orientate the problems given or found.
2. Organize students for learning.
3. Assist and direct students to carry out investigations independently, and in groups.
4. Develop and present their work and present it to their friends.
5. Analyze and evaluate the problem-solving process that has been done.

The use of the PBL model in learning will help students to practice conveying ideas, be actively involved in the learning process, be able and confident to express opinions and argue, and reflect on their perceptions so that understanding can be obtained by their own efforts, teachers can understand students' thinking processes and learning takes place according to students' abilities (Farida et al., 2018). Learning with PBL is not designed to facilitate teachers in conveying material or providing information to students but to help students develop thinking, problem-solving, and intellectual skills through organizing the learning process associated with real-life situations.

The characteristics of PBL learning, according to Akınoglu and Tandogan (Afif & Suyitno, 2016), are:

1. Students are given problems that are integrated with real life before starting the learning process.
2. Materials and activities in the learning process must prioritize students' conditions to attract students' interest.
3. The teacher accompanies, directs and guides during the learning process.
4. Students are allowed to collect information, develop problem-solving strategies.
5. The difficulty level of the problems must be by the students' abilities, so they don't give up.
6. The learning environment that is safe, comfortable, and quiet so that it supports the development of students' thinking to find solutions.

Based on the description above, it can be concluded that the Problem-Based Learning (PBL) learning model is an appropriate model and is suitable for use by teachers in the process of learning mathematics in class. Learning with PBL can train and guide students to solve the problems presented on their own so that student independence increases and trains student activity to participate in learning. These activities will affect students' reasoning abilities. The effect is to improve students' reasoning abilities. Several

relevant studies also show that the PBL learning model is proven to be able to enhance students' reasoning abilities.

Therefore, researchers want to conduct further discussions on the PBL learning model in improving students' mathematical reasoning abilities using the literature study method based on journals from previous studies. The purpose of writing this article is to provide broader knowledge and insight regarding the PBL learning model that can improve students' mathematical reasoning abilities..

METHOD

The approach used in this research is library research. Literature study is a method that uses library materials such as documents, books, magazines, historical stories, and others as a source for collecting data or information so that valuable conclusions can be drawn (Sugiyono, 2012). This research reviews the thoughts or findings from other relevant articles to obtain more precise and robust scientific information about the PBL learning model in improving students' mathematical reasoning abilities.

The main feature of this literature study approach is that the researcher collects and sorts his reference sources to be used. The reference sources used are articles that are ready to use so that researchers do not go directly to the field. Meanwhile, the technique used is a content analysis technique (Khairunnisa & Aziz, 2021).

The stages in analyzing data using this literature study are (1) summarizing several relevant articles, researchers can do this by reading the abstract, introduction, methods, and discussion; (2) taking the pretest, posttest, N-gain, indicators used, and PBL steps to be used as data in this study; (3) develop the data that has been obtained to be used as a basis for concluding; (4) re-checking the data that has been collected to avoid mistakes; (5) presenting selected data into a fascinating study; (6) draw conclusions from the results of the study (Yasinta et al., 2020).

FINDING AND DISCUSSION

There are a lot of previous research journals that are relevant to this research. If you search on Google Scholar, there are around 20 relevant studies. However, in this study, only five journals were used as a source of literature in conducting in-depth studies related to the PBL learning model in improving students' mathematical reasoning abilities. The criteria used by the author in selecting the journal to be used:

1. The dependent variable and the independent variable have similarities with this study.
2. The references used over the last ten years.
3. The language used is standard language that has been refined.
4. Proven have an ISSN to verify that the selected journal is accredited.
5. The journal used as a reference source is the most recent, conducted in the last ten years.

Based on these five criteria, the authors describe the five journals in the table below.

Tabel 1. **Relevant Journals**

No.	Journal title	year	Research purposes	Results and Discussion
1	Application of the Problem-Based Learning Model to Improve Students' Mathematical Reasoning Ability	2020	This experimental research aims to find out whether there is an increase in students' mathematical reasoning abilities through the Problem-Based Learning learning model on flat-sided space material at SMPN Model Sukabumi Regency.	The results of this study indicate that there is a difference obtained from the results of the hypothesis testing of students' posttest scores for the experimental class and the control class showing that $Thitung > Ttabel$, with the calculation results of 4.21 > 3.47 so that the value of $Thitung$ is in the receiving area H. It can be concluded that students treated with the Problem-Based Learning learning model had better abilities than those treated with the direct learning model.
2	The Effect of Problem-Based Learning Models on Students' Mathematical Reasoning Ability	2018	This study aimed to determine the effect of the Problem-Based Learning model on students' mathematical reasoning abilities in class VIII SMP Negeri 26 Bandarlampung in the 2017/2018 academic year.	From the results of testing the hypothesis using the t-test, it is obtained that the value is at a significant level of 0.05, then H0 is rejected. This means that the PBL model affects students' mathematical reasoning abilities. The average score of students' mathematical reasoning abilities who followed the PBL model increased by 26%, while the average score of students who followed conventional learning increased by

				16%. These data indicate that students who take PBL learning models are better at improving their mathematical reasoning abilities than traditional education students.
3	The Influence of the Problem-Based Learning (PBL) Learning Model on the Mathematical Reasoning Ability of Class XI Students of SMA Negeri 1 Meurebo	2019	This study aims to determine the effect of the Problem-Based Learning learning model and how much influence it has on the mathematical reasoning abilities of class XI students of SMAN 1 Meurebo.	Based on the study's results, the reasoning ability of students in the control class increased with an average of 77.80. While in the experimental style, students' mathematical reasoning abilities with an average score of 86.27. The difference in the average post-test results in the two classes was 8.47, or it could be said that the experimental class got a higher average score than the control class. This shows that learning using the cooperative learning model of the Problem-Based Learning (PBL) type is better than learning using conventional models.
4	The Effect of Problem-Based Learning (PBL) Models on Students' Mathematical Reasoning Ability	2017	The purpose of this study was to obtain an overview of the effect of the problem-based learning (PBL) model on students' mathematical reasoning abilities at SMP Negeri 1 Kibin	Based on the calculation results with the two average difference tests (t-test), a significance value of 3.2132 is obtained. This value is higher than 2.0126. This means H0 is rejected, and H1 is accepted. Thus, it can be concluded that the increase in the

				mathematical reasoning abilities of students who use Problem-Based Learning (PBL) model learning is better than students who take expository learning models.
5	The Effect of Problem-Based Learning Learning Model on Mathematical Reasoning Ability	2020	This study aimed to determine the effect of problem-based learning models on students' mathematical reasoning abilities at the Agriculture Vocational School of Serang City.	The P-Value for learning models with a Sig value more significant than, then, H0 is rejected. With a learning model Sig value of 0.040; then 0.040 <0.05 so it can be concluded that the Mathematical Reasoning Ability among students who obtain the PBL learning model is higher than students who receive the expository learning model.

Based on the above information, learning using the problem-based learning model is more effectively used to improve students' mathematical reasoning abilities than the learning teachers usually do in class. Several studies have shown the validity that there is a positive influence on the use of the PBL learning model. The materials used and educational levels are different in the five journals above. This shows that the PBL learning model can be used in all materials and classes of education from elementary to high school, does not affect the main variables in a study.

CONCLUSSION

Based on the five journals studied above, it can be concluded that the application of the Problem-Based Learning (PBL) learning model has a positive effect on increasing students' mathematical reasoning abilities. Therefore, using the PBL learning model can be an alternative solution for teachers in carrying out the learning process in class. The PBL learning model in its use is one of the teacher's strategies for solving problems that teachers encounter in the course besides that to improve student learning outcomes.

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