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# Application of Problem-Based Learning (PBL) Learning Model to Improve Student Learning Outcomes in Arithmetic Row Material Class XI SMAN 6 Southwest Aceh

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**ABSTRACT**

In this era of globalization, the low mathematics learning outcomes of students at the high school level, especially at SMAN 6 Aceh Barat South, are caused by the fact that in the learning process, teachers only focus on using less competent methods, so students get bored easily. The purpose of this study is to determine the completeness of student learning outcomes through Problem-Based Learning on Arithmetic Rows and Series Materials. This research is classified as a classroom action research that is carried out in two research cycles. In each research cycle, there are 4 stages consisting of planning, implementation, observation, and reflection stages. Data collection in the study was carried out using the test method. The data obtained in the study were then analyzed by analytical descriptive analysis techniques and qualitative descriptive analysis. The results of the study showed that the average student learning outcome in the pretest was 65.4 and increased in the post-test, which was 70.9. Based on these results, it can be seen that there is an increase in student learning outcomes in each cycle. Therefore, it can be concluded that the application of the problem-based learning model can significantly improve the mathematics learning outcomes of high school students.

## Introduction

In the implementation of education, there is a learning process, where students at each level are required to take part in certain subjects. One of the subjects taught at almost every level of education is mathematics. Mathematics is generally defined as the field of science about logic regarding shapes, arrangements, and concepts related to others (Rahman & Hapizah, 2021). The educational process is essentially an empowerment process, which is a process to reveal the potential that exists in humans as individuals who can then contribute to their nation. Education is increasingly important in the process of technological transformation, especially in today's era of globalization, especially

related to increasing knowledge in educational institutions through learning models (Khakim, Santi, US, Putri, & Fauzi, 2022).

To achieve learning targets, teachers are required to be able to develop and use the right learning model. In connection with this, efforts are made to provide opportunities for students to improve Mathematics learning outcomes by using a Problem-Based Learning model that is not only teacher-centered but also student-centered. One of the ways to strengthen understanding of Mathematics learning outcomes is learning that can provide opportunities for students to understand problems, provide answers or opinions, and then draw conclusions (Novelni & Sukma, 2021).

According to Sukma, (2021) one of the right learning models is the Problems Based Learning (PBL. Problem-Based Learning is a learning model that uses real problems that are unstructured and open, in addition, the Problem-Based Learning model that uses real problems with an open context and innovative learning can invite students to learn actively in solving problems.

The ability to understand concepts plays a big role in determining student learning outcomes in mathematics learning. Meanwhile, according to (Tyas, 2017), Problem-Based Learning (PBL) is one of the learning models that makes problems the basis for students to learn, problem-based learning is included in the category of teaching via problem-solving, where learning mathematical content is carried out through the presentation of inquiry-oriented problems. The problems presented in PBL are problems in daily life and these problems can stimulate students to learn this problem based on the knowledge and experience that students have had, so that from the experience that students have had, new knowledge and experience will be formed. Therefore, having this ability by students will make it easier to learn and solve mathematical problems. In mathematics learning activities, emphasis should be placed on activities that can increase understanding of concepts so that students have good basic skills to achieve other mathematical skills such as reasoning, communication, connection, and problem-solving. The learning process in the classroom by directing children to the ability to use formulas, memorize formulas, mathematics only to do problems, rarely taught to analyze, and use mathematics in daily life does not encourage children to develop their thinking skills (ASTUTI, 2022).

Based on the observations and experiences that the researcher has observed, the causes of students' lack of understanding of the material include students' interest in participating in learning is still low, students thinking the subject is difficult, students' initial knowledge is still low, students' low understanding of concepts, students lack learning the material that has been given, teachers have not maximized the application of innovative learning models. The Importance of Sharing Innovative Learning Practices Understanding the material, this learning practice is expected to motivate other teachers to design and implement innovative learning The role of a teacher who have the task of educating, teaching, guiding, directing, training, assessing, and evaluating students. According to (Nurlaelah, 2023), a teacher's responsibility is to carry out all stages or phases of innovative teaching (creative and innovative learning, which is integrated with

and by using learning methods, group discussions, and presentations so that learning goals can be achieved).

The Problem-based learning (PBL) learning model is one of the innovative learning models that can provide active learning conditions to students. Problem-Based Learning (PBL) is a learning model that uses real problems as a context for students to develop students problem-solving and critical-thinking skills. The problems used must be based on daily life that is close to the student's life so that students can find mathematical concepts on their own, especially arithmetic. The presentation of these problems can bring students closer to mathematics and students can know the benefits of mathematics in daily life and provide meaningful experiences in learning so that there can be an increase in student learning (Aklimawati, Mahmuzah, & Rahmat, 2019). The role of teachers includes a classroom manager who organizes and monitors student learning activities, becomes a facilitator and motivator in implementing Problem-Based Learning, ensures that Problem-Based Learning runs well, as a mediator between learning materials and students, namely the teacher's ability to create learning media that can bridge students with learning materials, and as an observer of student activity in the process Learning. The teacher's responsibility here is as an administrator who prepares learning tools according to the material and characteristics of students.

The error in determining the stage of problem-solving and the lack of understanding of the meaning of the problem are the causes of failure to solve the problem. These difficulties cause students to lack confidence when solving problems and have an impact on low student learning outcomes. The difficulties experienced by students are caused by a lack of attention and involvement of students in learning. For this reason, in the process of learning mathematics, students generally do not like the field of mathematics study. This is due to the tendency that what is displayed or taught to students is a series of abstract and boring formulas (Widyasari, Miyono, & Saputro, 2024).

Therefore, it is necessary to choose a learning model that increases attention and learning, so that students understand the meaning of formulas and concepts in arithmetic rows and series materials. Several studies show that the learning model can be used to improve learning achievement with the PBL model can be modified to further optimize the quality of learning. Powerpoint media can be used to make the PBL model more attractive. Problem-based learning (PBL) is a learning model with a student learning approach to authentic problems so that he can compile his knowledge, grow and develop higher skills and inquiry, make students independent, and increase confidence. In this case, a similar study was also conducted by (Mulbar, Bernard, & Pesona, 2018) who concluded that "through the application of the Problem-Based Learning (PBL) learning model on Arithmetic problem material, the completeness of learning outcomes can be achieved. Social arithmetic material is a material that has been taught since junior high school grade VII in the even semester. According to (Aslam, Suparji, & Rijanto, 2021) Social arithmetic material is one of the mathematics subject matter that must be understood by grade VII students, social arithmetic material includes sales and purchase prices, profits, losses, and break-even, profit and loss percentages, discounts, taxes, gross,

net value, and single interest. The social arithmetic material in this study is unit price, selling price, purchase price, profit and loss, profit and discount percentage.

Based on some of the explanations and theories above, the researcher is interested in conducting a study entitled "Application of Problem-Based Learning (PBL) Learning Model to Improve Student Learning Outcomes in Arithmetic Materials for Class XI SMAN 6 Aceh Barat South.

## Method

The method used in writing is a literature review. The literature studied is research books and articles. The books studied are related to Educational Psychology, and Teaching and Learning. The research articles studied are articles related to the Problem-based Learning model. The focus of the study is on the theoretical foundation of Problem-Based Learning, the character of the Problem-Based Learning (PBL) model, and the implementation of the Problem-Based Learning (PBL) model (Ardianti, Sujarwanto, & Surahman, 2021). The research approach used in this study is quantitative. The quantitative approach is numerical data processed using statistical methods.1 While the research method used in this study is the quasi-experimental method. The researcher used this method because the samples taken were ordinary classes without changing the existing structure. The design used in this study is the Pretest-Posttest Equivalent Group Design. This research was conducted in two classes, namely the control class and the experimental class. In the experimental class, a pre-test is given to see the ability of student learning outcomes, after which learning treatment is given using the Problem-Based Learning (PBL) learning model. After the learning is complete, students are then given a final test (post-test) to see changes in student learning outcomes. Similarly, in the control class, before the material is taught using direct learning, a pre-test will also be given. After the learning is completed immediately, the final test is given.

## Results and Discussion

In this study, student learning outcomes are seen from the results of the pre-test and post-test given. The test is in the form of an essay consisting of 3 questions. The learning outcomes are expected to be able to determine profits and losses and their percentages and be able to solve real problems related to profit and loss.

The results of the pre-test showed the initial condition of student learning outcomes which as a whole in the experimental and control classes were still resolved. However, after the two were given treatment, namely in an experimental class using the Problem-Based Learning (PBL) learning model. While the control class was treated using a direct learning model, only then did the difference in student learning outcomes in social arithmetic material be seen. This can be seen in the learning outcome scores in both classes. In the experimental class, it appears that the learning outcomes of students increase by using the Problem-Based Learning (PBL) learning model, this can be seen from the results of the post-test of the experimental class, where the average score of the post-test is higher than the average of the pre-test, where the average score of the pre-test

is 65.4 and the posttest is 70.9 by using the t-test at the level of significance = 0.05 and the degree of freedom (dk) = 24, the t-table of 1.71 and the t-count of 13.38 which means that the t-count is more from the t-table, it can be concluded that student learning outcomes increase with the Problem Based Learning (PBL) learning model.

During the learning process with the Problem-Based Learning (PBL) model, students are faced with a real problem. Students understand the problem by observing and reading the problem presented. Students look enthusiastic when observing and understanding the problem. Students also actively ask questions about things they do not understand, both to the teacher and their classmates. Students are also active in discussing and collecting information from books, as well as asking directly to teachers to solve problems in the LKPD that has been given.

At the stage of developing and presenting the work, students send two people from their group to present answers to the completed LKPD. Students confidently explain the results of their work to other visiting groups. This stage trains them to communicate the ideas they have gotten. In addition, students can creatively develop character in themselves. Based on the description above, it can be seen that the Problem-Based Learning (PBL) learning model can improve student learning outcomes. This is in line with research conducted by Yenni Fitria which concluded that "Through the application of the Problem-Based Learning (PBL) learning model, it can improve students' mathematics learning outcomes on problem-solving materials involving money (Yenni, 2019)".

Based on the results of data processing using N-Gain in the experimental class (table 4.4), it was found that 6 students had high n-gain values, 14 students had medium n-gain values and 4 students had low n-gain values. The results show that the n-gain value of the experimental class is in a moderate position. Meanwhile, in the control class (table 4.12), it was found that 2 students had a high n-gain level, 7 students at a medium n-gain level, and the remaining 16 students at a low n-gain level. The results show that the n-gain value in the control class is in a low position. In addition, the average post-test score of the learning outcomes of the experimental class students was (($\bar{x}$), = 70.9) and the average post-test score of the control class was (($\bar{x}$), = 57.56) It was seen that the average score of the experiment was higher than the average score of the control.

The data that has been analyzed obtained obtained the t-value for both classes, namely t-calculation = 3.1697 and t-table 1.68. This result results in t-calculation ≥ t-table, which is 3.1697 >1.68, thus it can be concluded that "the learning outcomes of students who are taught with the Problem-Based Learning (PBL) learning model are higher than the learning outcomes of students who are taught with direct learning".

**Table 1**
**Acquisition of pre-test and post-test data of the Experiment class**

| No | Name | Group | Skor pre-test | Post-test scores | N-Gain | Effectiveness |
|---|---|---|---|---|---|---|

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | AH | Experiment | 64 | 95 | 0,86 | Tall |
| 2 | AP | Experiment | 45 | 55 | 0,18 | Low |
| 3 | AR | Experiment | 60 | 82 | 0,55 | Keep |
| 4 | AA | Experiment | 60 | 85 | 0,63 | Keep |
| 5 | THREE | Experiment | 25 | 60 | 0,47 | Keep |
| 6 | FAA | Experiment | 15 | 70 | 0,65 | Keep |
| 7 | GT | Experiment | 20 | 82 | 0,78 | Tall |
| 8 | JR | Experiment | 25 | 85 | 0,80 | Tall |
| 9 | KR | Experiment | 20 | 84 | 0,80 | Tall |
| 10 | MN | Experiment | 15 | 73 | 0,68 | Keep |
| 11 | LS | Experiment | 50 | 92 | 0,84 | Tall |
| 12 | SR | Experiment | 45 | 95 | 0,91 | Tall |
| 13 | NS | Experiment | 21 | 64 | 0,54 | Keep |
| 14 | MP | Experiment | 5 | 70 | 0,68 | Keep |
| 15 | THE | Experiment | 35 | 79 | 0,68 | Keep |
| 16 | IN | Experiment | 45 | 80 | 0,64 | Keep |
| 17 | RK | Experiment | 15 | 40 | 0,29 | Low |
| 18 | KS | Experiment | 35 | 75 | 0,62 | Keep |
| 19 | CR | Experiment | 20 | 70 | 0,63 | Keep |
| 20 | NO | Experiment | 25 | 43 | 0,24 | Low |
| 21 | YEAR | Experiment | 10 | 70 | 0,67 | Keep |
| 22 | THREE | Experiment | 40 | 76 | 0,60 | Keep |
| 23 | CS | Experiment | 35 | 74 | 0,60 | Keep |
| 24 | NOT | Experiment | 15 | 71 | 0,66 | Keep |
| 25 | For example | Experiment | 10 | 36 | 0,29 | Low |

**Table 2**
**Acquisition of pre-test and post-test data of the Control class**

| No | Name | Group | Skor pre-test | Post-test scores | N-Gain | Effectiveness |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | AH | Experiment | 30 | 45 | 0,21 | Low |
| 2 | AP | Experiment | 65 | 69 | 0,11 | Low |
| 3 | AR | Experiment | 45 | 70 | 0,45 | Keep |
| 4 | AA | Experiment | 60 | 64 | 0,10 | Low |
| 5 | THREE | Experiment | 15 | 70 | 0,65 | Keep |
| 6 | FAA | Experiment | 25 | 40 | 0.20 | Low |
| 7 | GT | Experiment | 45 | 50 | 0,09 | Low |
| 8 | JR | Experiment | 40 | 52 | 0,20 | Low |
| 9 | KR | Experiment | 10 | 72 | 0.69 | Keep |
| 10 | MN | Experiment | 45 | 60 | 0,27 | Low |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | LS | Experiment | 24 | 35 | 0,14 | Low |
| 12 | SR | Experiment | 45 | 75 | 0,55 | Keep |
| 13 | NS | Experiment | 25 | 70 | 0,60 | Keep |
| 14 | MP | Experiment | 35 | 52 | 0,26 | Low |
| 15 | THE | Experiment | 20 | 80 | 0,75 | Tall |
| 16 | IN | Experiment | 45 | 60 | 0,27 | Low |
| 17 | RK | Experiment | 34 | 50 | 0,24 | Low |
| 18 | KS | Experiment | 35 | 75 | 0,62 | Keep |
| 19 | CR | Experiment | 30 | 80 | 0,71 | Tall |
| 20 | NO | Experiment | 15 | 35 | 0,24 | Low |
| 21 | YEAR | Experiment | 15 | 32 | 0,20 | Low |
| 22 | THREE | Experiment | 30 | 45 | 0,51 | Keep |
| 23 | CS | Experiment | 60 | 80 | 0,50 | Keep |
| 24 | NOT | Experiment | 20 | 35 | 0,19 | Low |
| 25 | For example | Experiment | 40 | 55 | 0,25 | Low |

The stages of Problem Based Learning (PBL) learning that the author believes can improve learning outcomes, namely the first stage and the third stage. The first stage is the stage of student orientation to the problem. At this stage, students are faced with real problems, students feel challenged and motivated to solve the problems presented. According to Ngalimun, if learning begins with a problem, especially a contextual problem, then there can be a cognitive imbalance in the student. This situation encourages curiosity so it raises various questions related to the problem. If the question has arisen, then their intrinsic motivation to learn will appear. The third stage is to guide the investigation independently or in groups. At this stage, students discuss defining problems, and then conduct experiments to get explanations and problem-solving in LKPD. So they construct their knowledge. This is in line with the view of constructivism expressed by Cobb (Suherman, 2013) who said that learning is seen as an active and constructive process where students try to solve problems that arise as they actively participate in mathematics exercises in class.

Based on the results of the above research, it can be concluded that problem-based learning is an effective learning model that benefits to supports students' achievement in learning Mathematics, especially Arithmetic row material.

## Conclusion

Based on the research that the author has carried out at SMAN 6 Aceh Barat South, the t-count > t-table was obtained which is 13.3885 > 1.71. At a significant level = 0.05. so it can be concluded that the learning outcomes of students who are taught with the Problem-Based Learning (PBL) learning model are higher than the learning outcomes of students who are taught with direct learning.

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