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Implementation of Problem-Based Learning to Improve Students' Learning Outcomes in Waves: A Case of MAN Balikpapan

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Abstract: This research is a pre-experimental research that aims to determine the physical learning outcomes of students at MAN Balikpapan who are taught using problem based-learning. The independent variable in this study is problem based-learning and the variable is the student's physics learning outcomes on the subject matter of sound waves. The research subject is class XI MIPA 1 MAN Balikpapan which has 33 participants The research data by giving a test of learning outcomes on the subject matter of the wave in the form of a posttest. The data analysis technique is descriptive analysis in the form of the average score of learning outcomes, standard deviation and variance. Based on descriptive analysis, the average score of learning result in class XI MIPA 1 is 82,97. It can be said that the physical learning result of students who are taught using problem based-learning are in the very high category.

Keywords: problem based learning, learning outcomes, waves concept.

Abstrak: *Penelitian ini adalah penelitian pra-eksperimen yang bertujuan untuk mengetahui hasil belajar fisika peserta didik di MAN Balikpapan yang diajar menggunakan pembelajaran berbasis masalah. Variabel bebas dalam penelitian ini adalah pembelajaran berbasis masalah sedangkan variabel terikat adalah hasil belajar peserta didik pada materi gelombang bunyi. Subjek penelitian yaitu kelas XI MIPA 1 MAN Balikpapan yang mempunyai jumlah peserta didik sebanyak 33 orang. Data hasil penelitian diperoleh dengan pembeerian tes hasil belajar pada materi pokok gelombang bunyi berupa posttest. Teknik analisis data dengan analisis deksriptif berupa rata-rata skor hasil belajar, standar deviasi, dan varians. Berdasarkan hasil analisis deskriptif, skor rata-rata hasil belajar pada kelas XI MIPA 1 sebesar 82,97. Hal ini dapat disimpulkan bahwa hasil belajar fisika peserta didik yang diajar menggunakan pembelajaran berbasis masalah berada pada kategori sangat tinggi.*

Kata kunci: *pembelajaran berbasis masalah, hasil belajar, konsep gelombang.*

▪ INTRODUCTION

Twenty first century learning is a learning transition where the curriculum developed leads schools to change the learning approach from teacher centered to student centered. This is in accordance with future demands where students must have the skills to think and learn. Therefore, (Nuzulika et al., 2022) Learning system and improving the competence of graduates who have 21st century skills, namely problem solving skills (critical thinking and problem solving), critical thinking (creativity and innovation), collaboration (collaboration), and communication skills. (communication) or what is known as the 4C.

Learning in the 2013 curriculum has the aim of developing the talents, interests, and potential of students to be characterized, competent, and literate. The learning experience requires learning that varies from simple to complex. The 2013 curriculum that is applied has 4 learning models that can be used, one of which is problem-based learning, where using this learning is in line with 4c skills, namely problem solving

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(critical thinking and problem solving). So that the implementation of learning and assessment becomes relevant to 21st century learning.

Physics is a science in which it learns about the nature and natural phenomena or natural phenomena and all interactions that occur in them. The nature of physics is divided into three, namely physics as a product (a body knowledge), as an attitude (a way of thinking), and as a process (a way of investigating). Physics as a process is a series of structured and systematic activities carried out to find concepts, principles and laws about natural phenomena. Physics as a product because it consists of a collection of knowledge in the form of facts, concepts, principles and laws of natural phenomena. While physics is an attitude because it is expected to be able to develop students' character (Himah et al., 2015). The purpose of this study was to determine the students' physics learning outcomes after problem-based learning was applied.

The teacher's role in problem-based learning is to present problems, ask questions, and facilitate inquiry and dialogue. Problem-based learning is a learning that involves students to solve problems through the stages of the scientific method so that students can learn knowledge related to the problem and at the same time have the skills to solve problems. According to (Kharida et al., 2009) it was found that the application of problem-based learning can improve students' cognitive learning outcomes and learning activities of students and teachers increase when using problem-based learning models. According to Tan in (Rusman, 2016) problem-based learning is an innovation in learning because in problem-based learning students' thinking skills are really optimized through a systematic group or team work process, so that students can empower, hone, test, and develop their skills. think continuously. In addition, according to Hudojo in (Sam & Qohar, 2015) explains that in solving problems students are expected to understand the process of resolving relevant conditions and concepts, seek generalizations, decide on plans to complete and organize previously possessed skills.

To implement problem-based learning, teachers need to choose subject matter that has problems that can be solved. These problems can be taken from textbooks or other sources, for example from events in the surrounding environment. Judging from the context of improving the quality of education, problem-based learning is one of the learning models that can be used to improve systems that occur in the surrounding environment, from events that occur in the surrounding environment and events in the family or community. According to Arends in (Muis, 2019) that problem-based learning has the following characteristics: 1) problem-posing or statements, namely organizing teaching around questions of socially important and personally meaningful problems for students 2) focusing on inter-discipline linkages, namely allowing centered on several subjects 3) authentic investigation, namely conducting investigations to find real solutions to real problems 4) producing products and exhibiting them, which requires students to produce certain products in the form of real work 5) collaboration, which is characterized by students who work with each other in pairs.

Problem-based learning is designed to help students develop their thinking, problem solving, and intellectual skills, learn to act as adults with real experiences or adapted situations and become independent learners (Lismaya, 2019). According to Polya in (Sam & Qohar, 2015) problem-solving steps consist of a) understanding the problem, students determine what is known and asked; b) draw up a plan, students connect the knowledge they have previously or similar problems that have been solved

before with what is known and asked in the problem so that they can make a solution; c) carry out the plan, students perform calculations (computing); and d) re-checking, students make re-corrections about solving the problems made. Problem-based learning has a syntax that is student orientation to problems, organizing students to learn, guiding individual/group experiences, developing and presenting work, as well as analyzing and evaluating problem solving processes (Johnson, B, 2007). Learning outcomes are changes in behavior after learning occurs. Behavior in this case includes three aspects, namely cognitive, affective and psychomotor. In the Big Indonesian Dictionary (KBBI) it means, among other things, results (from matches, exams and so on) (Yasin, 2013). So it can be concluded that where the word results are associated with learning, learning outcomes are a result of learning which is used as a measure of a student in the learning process obtained by students in the form of changes in behavior and certain abilities.

▪ METHOD

Research Design and Procedures

The type of research used is pre-experimental research, which is a research design that has not been categorized as a real experiment. The research design is a one-shot case study design where the treatment is given to one group so that there is no control group as a comparison to the experimental group. The treatment was given and then the results were observed by carrying out a posttest. The independent variable is problem-based learning, and the dependent variable is student learning outcomes. The research was carried out for 1 month with a preparation stage, namely before taking data, all needs were prepared such as research permits, teaching materials, and learning tools. Followed by the implementation stage where in the MAN Balikpapan school, learning and posttest were carried out, and the final stage was the process of analyzing research data, compiling research results and then in seminars.

Participants

In this study, research subjects were used, this was based on the type and research design used.sampling has not been carried out random, so that in this study the subjects were selected directly without using a sampling technique. So, the research subject selected was class XI MIPA 1 MAN Balikpapan in the 2021/2022 academic year which had 33 students.

Instrument

The instrument used in this research is a test instrument in the form of a description. The test instrument for learning physics results consists of 20 questions. Before the instrument is used, the Gregory validation test and empirical test are carried out first. The Gregory validity test is an instrument test carried out by two experts, where the validation results are then cross tabulated to determine the validity and invalidity of the instrument. The test results of the test instrument obtained a value of 1, where the instrument can be said to be valid if $r_{count} > 0.75$, so it can be stated that each item of the instrument can be used for the next stage.

Empirical validity test is a test conducted on students at school. The empirical test was carried out in class XII MIPA. As many as 20 questions that were carried out empirically, 10 questions were valid. It is known that based on the results of empirical test analysis, the question is declared valid if rcount > rtable , i.e. rcount > 0.44. Then

the 10 questions were used to collect data in class. As for the 10 questions that meet the criteria, they are divided into 4 questions C3, 4 questions C4, 1 question C5 and 1 question C6. The indicators contained in these questions are about the characteristics of sound waves, speed of sound, sound in various substances, the effect of temperature on sound, the Doppler effect, open and closed organ pipes, and sound intensity and intensity level. One of the questions is "The frequency of the second overtone of an open organ pipe is the same as the frequency of the first overtone of a closed organ which is blown at the same temperature. The ratio of the length of the open organ pipe to the length of the closed organ pipe?

The scoring guidelines for the learning outcomes test instrument are at the C3 level with 5 scores, the C4 level with 10 scores, the C5 level with 15 scores and the C6 level with 25 scores. Giving different scores on each question due to differences in the cognitive level of each question. At each cognitive level there are several indicators that must be mastered by students, where each cognitive level increases, the level of difficulty and complexity of the questions also increases so that students' complex thinking skills are needed. With this, teachers can find out the limits of students' abilities (Educational Assessment Center Team, 2019).

Data analysis

This research is a quantitative research that processes data in the form of numbers to answer the formulation of the problem. Descriptive statistics serve to describe or provide an overview of the object being studied. As it is, without conducting analysis and making generally accepted conclusions. The descriptive analysis used in this study consisted of the average score of students' physics learning outcomes, the highest empirical score, the lowest empirical score, variance and standard deviation.

▪ RESULT AND DISSCUSSION

An overview of student learning outcomes on wave material in class XI MIPA 1 for the 2021/2022 academic year which is taught using problem-based learning. Based on the results of the descriptive analysis carried out, it was found that the 33 students who joined in one class, the ideal score that can be obtained by students is 100 and the lowest ideal score that can be obtained by students is 0. After the posttest , the highest score obtained is obtained. is 91 and the lowest score obtained is 75. Then the average score is 82.97, the standard deviation is 4.38 and the variance is 19.16. Judging from the average score of students' physics learning outcomes, the category of students' physics learning outcomes for class XI MIPA 1 academic year 2021/2022 is in the very high category. The results of this study are in line with research conducted by In addition, (Putri et al., 2017) The average score of students' understanding of physics concepts after being given treatment in the form of problem-based learning becomes higher.

The score of students' physics learning outcomes can be categorized based on the categorization of students' physics learning outcomes. the highest result is in the category of very high learning outcomes with an interval of 80 - 99 is in the percentage of 84.85%. While in the category of high learning outcomes with an interval of 60 – 79 is at a percentage of 15.15%, then in the medium category with an interval of 40 – 59, a low category with an interval of 20 – 39, and a very low category with an interval of 0 – 19 is in the percentage of 0.00%. The average posttest of students on each question can be seen in Figure 1 as follows:

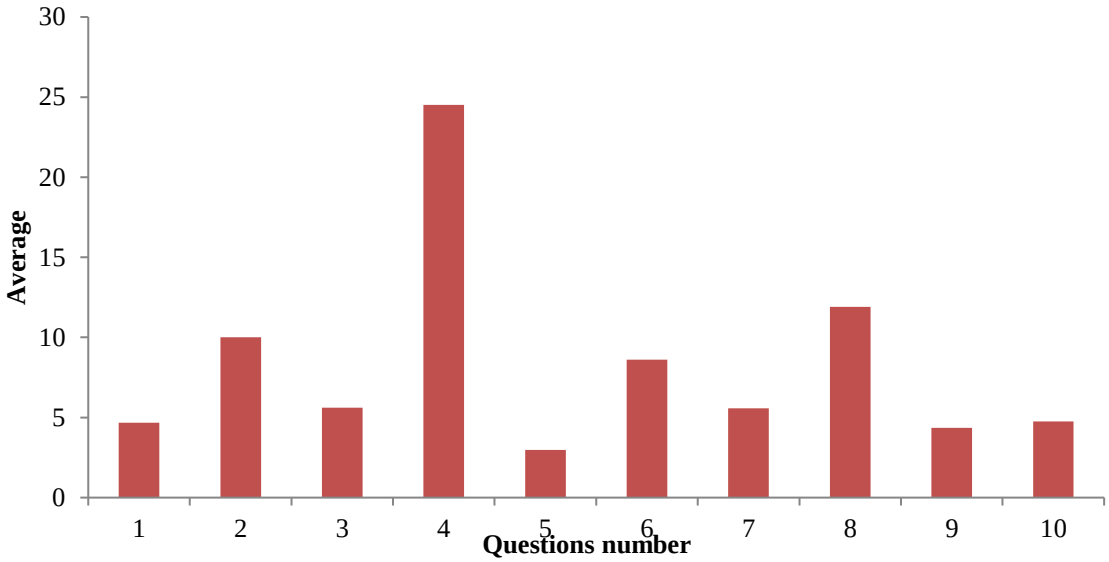

Figure 1. Posttest average score for each question

This study aims to determine the physics learning outcomes of students who are taught using problem-based learning on student learning outcomes at MAN Balikpapan in physics subjects, especially on wave material. sound. The material taught refers to the 2013 curriculum as a reference in making Learning Implementation Plans (RPP) and teaching materials as well as Student Worksheets (LKPD).

The results showed that by applying problem-based learning in learning activities, it could increase student participation in learning activities. Students can actively carry out learning activities in accordance with the learning steps. This is in line with research (Lubis et al.,2019) Problem-based learning is indeed very effective for improving student learning outcomes and critical thinking skills. Not only that, learning activities also become active. There is a synergy between cognitive, affective and psychomotor learners. Of course this is realized when learning is carried out not only once, but again and again.

According to (Sarwandi et al., 2022) By applying problem-based learning, students are more active in analyzing and solving problems relevant to learning objectives, gaining new knowledge, and being able to develop the skills and self-direction needed for further learning. Students feel more challenged in learning activities in the classroom. In addition, (Khoiriyah & Husamah, 2018) Problem Solving is the stage where students mobilize their skills to find answers to problems. Problem-based learning can train students to develop and explore problems by increasing awareness of different ways of thinking and solving problems. While the opinion of (Pasangkin et al., 2015) states that the use of problem solving because it has several advantages, namely the technique used is good enough to better understand the content of the lesson, problem solving can challenge the ability of students to find new knowledge and help students transfer their knowledge to understand problems in real life.

One of the activities in the learning that is carried out is a discussion with friends to form a small group, this is done so that students can measure their ability to solve problems with each other. This is in line with (Cindy & Silver, 2004) Study groups are the key to problem-based learning, with groups of students enabling the entire group to overcome problems that are usually too difficult for each student. Furthermore, research shows that small group discussions and debates in learning sessions enhance problem solving and higher order thinking.

There were several obstacles in the research process carried out, such as learning activities that were still carried out with blended, so that in learning there was less direct interaction. The shorter learning time in one hour lesson poses a challenge for teachers to be able to convey material well but still pay attention to learning time so that teaching and learning activities can take place efficiently. Research with problem-based learning provides changes in student learning outcomes, this can be seen from the average score of post-test which is 82.97 which is above the KKM set by the school of 78. The results of the analysis of physics learning outcomes for class XI students MIPA 1 illustrates that the number of students who exceed the KKM is 28 people. These results illustrate that the mastery of students' physics learning outcomes after problem-based learning is applied is greater than the students' physics learning outcomes before being given treatment in the form of problem-based learning. This is in line with research (Nurlina et al., 2015) that students' physics learning outcomes after being taught using problem-based learning are in the high category. In another study, namely (Nurcaya et al., 2011) there was an increase in the physics learning outcomes of students who were taught using problem-based learning. In addition, (Timor et al., 2021) The use of problem-based learning can improve learning outcomes for the material being studied and increase student activities in learning both at school and at home, which will affect the improvement of learning outcomes.

The results of the descriptive analysis showed that the average score in the class was 82.97 with a standard deviation of 4.38, besides the results of the analysis it can be seen that the learning outcomes of students who are taught using problem-based learning at MAN Balikpapan are in the "very high" category. with a percentage of 84.85%. According to (Sari et al., 2017) the application of problem-based learning has an effect on student learning outcomes. The learning outcomes of students who are taught using problem-based learning are better than the learning outcomes of students who are taught using other types of learning. Then (Celik et al., 2011) it is said that problem-based learning is more effective than traditional learning methods in improving the achievement of prospective teachers in physics courses. This is presumably because problem-based learning is student-centered, helps construct information, and conducts meaningful learning. According to (Delisle, 1997) At the end of the problem-based learning activity, the teacher has watched the participants do thinking about possible solutions, review their knowledge, determine key questions, develop research methodologies to find facts, conduct research, adapt research to problems to develop solutions, explain their reasons, produce the final product, and present the product. Through each of these stages the teacher evaluates the performance of each student, both individually and as part of a group. In addition, teachers can assess their effectiveness as process facilitators and the success of problems in improving what students know and can do. Each teacher needs to determine the specificity of the

evaluation needed to assess class performance to improve subsequent problem-based learning activities, or to provide value to students.

The results showed an increase in student learning outcomes. Individual and group mastery has been achieved in accordance with predetermined criteria. Finally, the use of problem-based learning can be used as a recommendation for the purpose of improving student learning outcomes. In problem-based learning the role of motivation, cues, encourages active participation of students (Evendi & Verawati, 2021). In this research. in the learning process carried out some students cannot follow the learning effectively, this is dominated when the learning process is carried out online. In addition, more students like learning when using pictures and videos. When learning occurs in the classroom, students are active in asking questions. In addition, during learning takes place as a teacher must ensure that every student can understand the material presented. So that it can improve student learning outcomes.

▪ CONCLUSION

Based on the results of the research, descriptive data analysis carried out and the discussion, it can be concluded that the physics learning outcomes of students at MAN Balikpapan in class XI MIPA 1 for the academic year 2021/2022 who are taught using problem-based learning are in the very high category. With this research, it is hoped that in the teaching and learning process in the classroom, learning that is appropriate to the material can be used, one of which is problem-based learning on sound wave material, so that students' physics learning outcomes can increase. However, the lack of time to carry out learning activities in the classroom makes some communication errors and learning activities that still use the blended make some students unable to follow the lesson properly so that it affects learning outcomes.

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