Implementation of Problem Based Learning on Physics Learning Outcomes of Students at MAN 1 Makassar

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Abstract *- This research is a pre-experimental study that aims to find out how the visual learning outcomes of MAN 1 Makassar students are described after being taught using problem-based learning with experimental methods. The independent variable of this research is problem-based learning with experimental methods, while the dependent variable is the learning outcomes on the subject matter of harmonic vibrations. The subjects in this study were class X MIPA 1 as an experimental class with 37 students. The research data were obtained by giving a learning achievement test on harmonic vibration material that met valid criteria with 17 questions. The results of the descriptive analysis show that the average score of students who are taught using problem-based learning with experimental methods is 13.51 with a standard deviation of 1.95. The category of learning outcomes obtained is in the "high" category and the highest proportion of cognitive domain levels in learning outcomes is in category C2 (understanding) and the lowest is in category C4 (analyzing).*

Keywords: *Problem-Based Learning; Learning Outcomes.*

INTRODUCTION

Education is a conscious and planned effort to create a learning atmosphere or learning process, allowing learners to actively develop their potential in spiritual strength, religious beliefs, self-control, personality, intelligence, noble character, as well as the skills necessary for themselves, society, nation, and country (Nurkholis, 2013). Through education, we can shape individuals with noble virtues and civilization, making education crucial for everyone from an early age (Wilujeng & Suliyanah, 2021).

The objectives of physics learning within the framework of the 2013 Curriculum are to master concepts and principles, possess skills in developing knowledge, and cultivate self-confidence as a foundation for advancing to higher levels of education. Additionally, it aims to contribute to the development of science and technology (Suharto, 2015). A key factor in achieving these learning objectives is the active participation of students, reflected in their learning outcomes. Learning outcomes signify a change in behavior, such as transitioning from ignorance to knowledge or from not understanding to understanding (Audie, 2019).

The effectiveness of learning outcomes is influenced by the teaching process created by the teacher. Teachers capable of delivering engaging learning processes indirectly stimulate students to actively pay attention to the lessons (Saputra et al., 2013). Teachers utilize learning outcomes as measures or criteria to assess the success of students in studying physics, often determined through assessments like tests (Juarsih et al., 2017).

Based on results observations made by researchers, facts in the field demonstrated in class of X MIPA MAN 1 Makassar in lesson 2023/2024, indicates that students are insufficiently actively engaged in the physics learning process. They tend to be passive and bored, facing difficulties in comprehending the subject matter. This is attributed to the continued use of

conventional teaching methods, specifically the lecture method. The lecture method involves oral narration and explanation by the teacher, occasionally supported by teaching aids to clarify concepts for students (Jafar, 2021). The drawback of conventional learning lies in the limited understanding of the subject matter by students, as it relies on what the teacher knows. This lack of demonstration can lead to verbalism, a monotonous learning process, and passive students, preventing them from independently discovering the taught concepts, thereby impacting their learning outcomes (Karwono & Irfan, 2020).

Based on the above description, there exists a gap between expectations and reality. Consequently, the researcher proposes problem-based learning as a solution. Problem-based learning is recommended by Permendikbud No. 65 of 2013 on process standards. It is chosen for its ability to encourage students to be more active, making the teaching and learning process more enjoyable, critical, and independent in acquiring knowledge, enhancing their understanding of the subject matter (Rachmad et al., 2019).

Problem-based learning involves presenting students with real problems they may have experienced (Ardianti et al., 2021). This method focuses on making students independent learners actively engaged in group learning, helping them develop critical thinking skills and problem-solving abilities through data research to find solutions (Pitriah et al., 2018).

Problem-based learning can be particularly effective in physics education. Physics explores natural phenomena and discusses how these phenomena occur (Hadi & Dwijananti, 2015). The problem-based learning process engages students' minds in exercises that involve reflection, articulation, and learning to see differences in perspectives. The use of problem scenarios and their sequences in problem-based learning can aid students in developing cognitive connections (Rusman, 2014).

Problem-based learning prioritizes the learning process, with the teacher's role focused on assisting students in achieving self-directed skills (Hotimah, 2020). The process begins by dividing students into groups, and presenting them with a problem. Students attempt to solve it using their existing knowledge while seeking relevant new information. They identify the problem, formulate hypotheses, list what they need, and explore the experimental activities required. Subsequently, they create reports, present to peers, incorporate feedback or revisions, and conclude whether their hypotheses are accepted or rejected (Shofiyah & Wulandari, 2018).

Problem-based learning possesses several characteristics, including: 1) Student-centered, 2) Problems as the starting point are real-world, unstructured, integrated across disciplines, and require investigation, 3) Teacher as a facilitator, 4) Collaboration and communication are crucial for building student cooperation in problem-solving, 5) Evaluation to assess students' knowledge progress (Zainal, 2022).

The advantages of problem-based learning lie in not merely presenting information for memorization but ensuring that the information used is for problem-solving, fostering meaningful engagement with information. Its application encourages students to take initiative in their learning process, requiring active participation in identifying and solving problems. Furthermore, it provides the freedom to explore alongside peers under the guidance of the teacher, making it enjoyable and motivating for students to continue learning (Paat & Mokalu, 2023).

Based on the above description, the researcher conducts a study on the "Implementation of Problem-Based Learning on Physics Learning Outcomes of Students at MAN 1 Makassar."

RESEARCH METHODS

This research is quantitative research and pre-experimental research and uses a One-Shot Case Study design which was carried out in the 2023/2024 academic year. The subjects in the research were students of class X MIPA 1 at MAN 1 Makassar, totaling 36 students.

The data collection methodology employed a multiple-choice test instrument designed to evaluate student learning outcomes after the implementation of problem-based learning, denoted as the posttest. The test's validity was substantiated through validation procedures, attaining a validation standard of 0.344 and meeting reliability criteria during a trial

The research procedure encompassed three stages: 1) The preparation phase involved site observations, interviews with physics educators at MAN 1 Makassar regarding students' physics learning conditions, administrative tasks, the creation of instructional materials such as the lesson implementation plan (RPP), student worksheets (LKPD), teaching materials, and making research instruments; 2) The implementation phase, during which the selected class underwent problem-based learning, culminating in a physics learning outcome test; and 3) The final phase, which involved data processing and the descriptive analysis of students' physics learning outcomes. After the data analysis, the thesis writing stage commenced, yielding conclusions about the portrayal of the physics learning outcomes of class X MIPA 1 at MAN 1 Makassar following instruction through problem-based learning.

Data obtained were analyzed using descriptive statistics, aiming to describe the data without intending to draw generalizable conclusions. The analysis provides an overview of students' learning outcome scores, including average scores, highest and lowest scores, standard deviation, and variance. Student learning outcome categories are determined based on standard categorization adapted from Riduwan, (2019) as presented in the following table.

Table 1. Learning Outcome Categories

No	Score Intervals	Learning Outcome Category
1	81-100	Very High
2	61-80	High
3	41-60	Average
4	21-40	Low
5	0-20	Very Low

RESULTS AND DISCUSSION

Results

Based on the analysis of the physics learning outcomes of class X MAN 1 Makassar in the academic year 2023/2024, the results are detailed in the following table.

Table 2. Statistics Score Learning Results of MAN 1 Makassar Students After Being Taught Using Problem Based Learning

Statistics	Statistical Value
Total of Samples	37
Highest Score Empirical	16
Lowest Score Empirical	8
Ideal Highest Score	17
Ideal Lowest Score	0
Average Score	13.51
Variance	3.81
Standard Deviation	1.95

Based on Table 2 above, shows that the highest score achieved by students in learning physics after being taught using problem-based learning is 16 and the lowest score achieved is 8 from the ideal score of 17 that is possible to achieve. The average score obtained by students was 13.51 with a

variance of 3.81 and a standard deviation of 1.95. Based on results analysis statistics descriptive results study physics participant educate class X MAN 1 Makassar can be determined category score results study physics according to Riduwan, (2019) in Table 3 below.

Table 3. Classification of Physics Learning Outcome Scores for MAN 1 Makassar Students After Being Taught Using Problem Based Learning

Interval Score		Frequency	Percentage (%)
Percentage (%)	Number		
81 - 100	13,7 - 17	20	54,05
61 - 80	10,3 - 13,6	14	37,84
41 - 60	6,9 - 10,2	3	8,11
21 - 40	3,5 - 6,8	0	0
0 - 20	0 - 3,4	0	0
Total		37	100

Based on Table 3 above, it can be concluded that students' physics learning outcomes after being taught using problem-based learning are in the "High" category. More details can be seen in the following Frequency distribution graph.

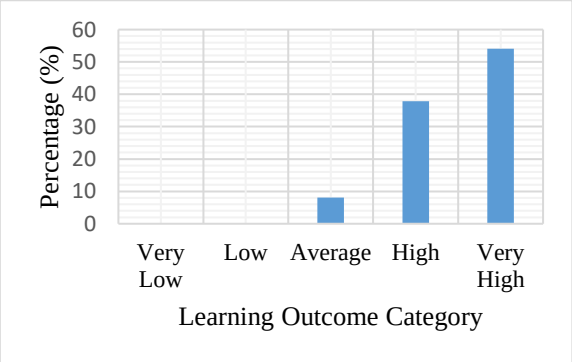

Figure 1. Physics Learning Outcomes of Students

The Category of Learning Outcome obtained is based on the average estimate, namely in Table 4 below

Table 4. Categories of Students' Physics Learning Outcome Scores After Being Taught Using Problem-Based Learning

Score	Category	Frequency	Percentage (%)
14-17	High	20	54.05
8-13	Low	17	45.95

An overview of the percentage scores of students' physics learning outcomes based on cognitive domain indicators is as follows.

1. C2 (Understanding)

Statistical data showing the level of thinking in the C2 (understanding) cognitive domain of students in physics learning outcomes after being taught using problem-based learning can be seen in Table 5 below.

Table 5. The Statistics Score of Physics Learning for MAN 1 Makassar Students Based on the Cognitive Domain C2

Statistics	Statistical Value
Number of Samples	37
Highest Score Empirical	4
Lowest Score Empirical	2
Ideal Highest Score	4
Ideal Lowest Score	0
Average Score	3.68
Variance	0.28
Standard Deviation	0.53

Based on table 5 above, it shows the average score obtained from 37 students in the C2 domain, namely 3.68 from the ideal score of 4. The category of learning outcome is based on the average estimate, which can be seen in Table 6.

Table 6. Category of Physics Learning Outcome Scores for MAN 1 Makassar Students in the Cognitive Domain C2

Score	Category	Frequency	Percentage (%)
4	High	26	70.27
2-3	Low	11	29.73

Based on table 6 above, it can be obtained that the highest frequency is the number of questions answered correctly by students, namely those who answered 4 questions with a frequency of 26. The lowest frequency is the number of questions answered correctly by students, namely those who answered 2 and 3 questions with a frequency of 11 for cognitive domain C2.

2. C3 (Applying)

Statistical data showing the level of thinking in the C3 (Applying) cognitive domain of students in physics learning outcomes after being taught using problem-based learning can be seen in Table 7 below.

Table 7. The Statistics Score of Physics Learning for MAN 1 Makassar Students Based on the Cognitive Domain C3

Statistics	Statistical Value
Number of Samples	37
Highest Score Empirical	4
Lowest Score Empirical	2
Ideal Highest Score	4
Ideal Lowest Score	0
Average Score	3.43
Variance	0.53
Standard Deviation	0.73

Based on Table 7 above, it shows the average score obtained from 37 students in the C3 domain, which is 3.43 from the ideal score of 4. The Category of Learning Outcome is based on the average estimate, which can be seen in Table 8.

Table 8. Category of Physics Learning Outcome Scores for MAN 1 Makassar Students in the Cognitive Domain C3

Score	Category	Frequency	Percentage (%)
4	High	21	56.76
2-3	Low	16	43.24

Based on Table 8 above, it can be obtained that the highest frequency is the number of questions answered correctly by students, namely those who answered 4 questions with a frequency of 21. The lowest frequency is the number of questions answered correctly by students, namely those who answered 2 items. questions and 3 questions with a frequency of 16 for cognitive domain C3.

3. C4 (Analyzing)

Statistical data showing the level of thinking in the cognitive domain C4 (Analyzing) of students in physics learning outcomes after being taught using problem-based learning is in Table 9 below.

Table 9. The Statistics Score of Physics Learning for MAN 1 Makassar Students Based on the Cognitive Domain C4

Statistics	Statistical Value
Number of Samples	37
Highest Score Empirical	9
Lowest Score Empirical	3
Ideal Highest Score	9
Ideal Lowest Score	0
Average Score	6.41
Variance	1.75
Standard Deviation	1.32

Based on Table 9 above, it shows the average score obtained from 37 students in the C4 domain, namely 6.41 from the ideal score of 9. The Category of Learning Outcome is based on the average estimate, which can be seen in Table 10 following.

Table 10. Category of Physics Learning Outcome Scores for MAN 1 Makassar Students in the Cognitive Domain C4

Score	Category	Frequency	Percentage (%)
7-9	High	20	54.05
3-6	Low	17	45.95

Based on table 10 above, it can be obtained that the highest frequency is the number of questions answered correctly by students, namely those who answered 7-9 questions with a frequency of 20. The lowest frequency is the number of questions answered correctly by students, namely those who answered 3-6 questions with a frequency of 17 for cognitive domain C4.

The description of students' achievements in answering physics questions when viewed from each learning outcome indicator is in Table 11 below.

Table 11. Students' Physics Learning Outcome Scores in Each Cognitive Domain

Learning Outcome Indicator	Average Score		Score Ideal
	Score	Percentage (%)	
C2	3,68	92	4
C3	3,43	85,75	4
C4	6,41	71,22	9

Based on Table 11 above, it can be seen that the highest percentage score in the cognitive domain is at level C2 (understanding) and the lowest is at level C4 (analyzing). There were 92% of students who could answer questions correctly about C2, 85.75% about C3, and 71.22% about C4. This shows that most students in class X MIPA 1 MAN 1 Makassar can answer questions correctly at level C2 and at least students can answer questions at level C4. More details can be seen in the following figure.

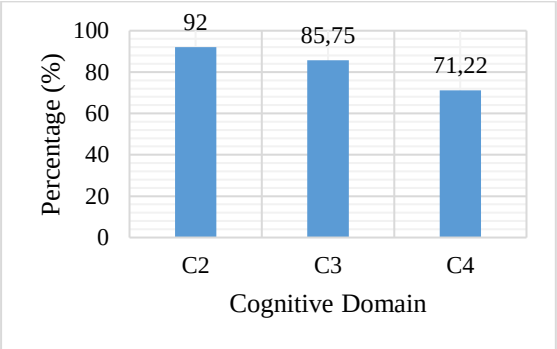

Figure 2. Percentage of Physics Learning Outcome Scores in Each Cognitive Domain

The percentage of each cognitive domain, namely C2 (understanding), C3 (applying), and C4 (analyzing) obtained by each student, is in Figure 3 below.

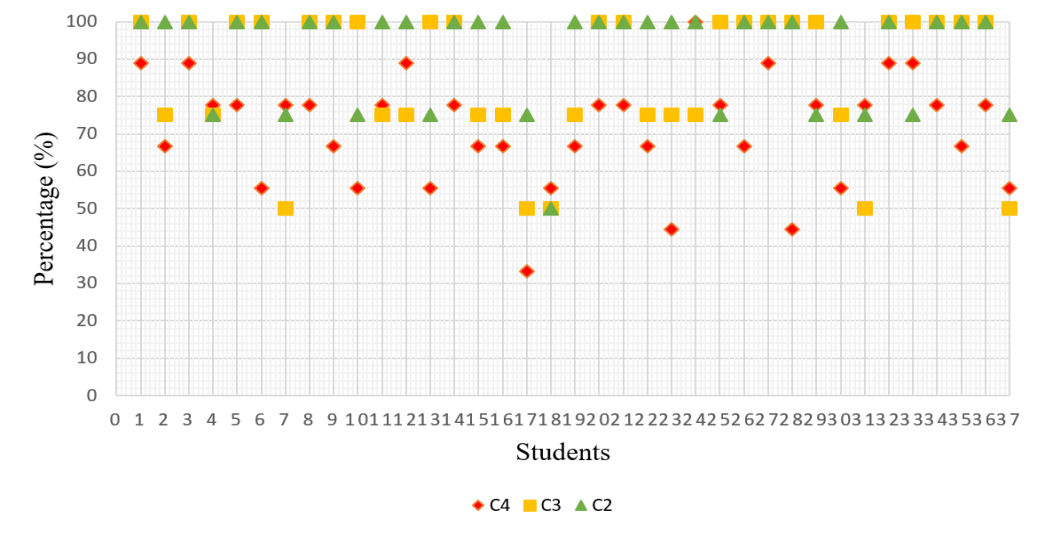

Figure 3. Percentage Score Obtained by Each Student for Each Cognitive Domain

Discussion

This study aims to assess the learning outcomes in physics after implementing problem-based learning for class X MIPA 1 at MAN 1 Makassar. Descriptive analysis reveals an average physics learning outcome score of 13.51 out of an ideal score of 17, categorizing it as high. Participants' scores were further categorized on a five-point scale, with no students scoring very low or low. 8.11% achieved a moderate score, 37.84% scored high, and 54.05% scored very high. Results obtained due to problem-based learning participants sued for active in learning through solution problem. The learning process will help participants educate in develop an understanding more concepts. In search solution to the problem the participants face to face with related and applying concepts more understanding deep so that will develop the ability to think critically participants educate. Apart from that, in the solving process problem is also done something method experiment, where use method experiment will give the opportunity and experience direct to participant educate for do experiment and prove something he learned so the learning process will be more effective (Pratiwi et al., 2018).

Results obtained in the research This in line with research that has been done by Asdar et al, (2020) regarding "Penerapan Model Pembelajaran *Problem Based Learning* Terhadap Hasil Belajar Fisika Peserta Didik Kelas XI MIPA 3 SMA Negeri 8 Gowa" from analysis statistics show that category results study physics of students at XI MIPA 3 SMAN 8 Gowa after applied learning model problem-based learning are in the category high. Additionally, results study this is also in line with research conducted by Putriyanti et al., (2020) regarding "Pengaruh Model *Based Learning* Berbasis Metode Eksperimen Terhadap Hasil Belajar Fisika Siswa Kelas XI SMA Negeri 4 Palu" where based on analysis of the data obtained there is difference score between class experiments and classes control, where an average score of experiment class more big compared to with control class.

The percentage distribution of learning outcome scores based on cognitive domains indicates that students performed better in C2 (understanding) and struggled more with C4 (analyzing). This suggests that students of class X MIPA 1 at MAN 1 Makassar, face challenges in solving analytical-level problems but find it easier to handle problems at the understanding level. This disparity is attributed to the problem-based learning process, where students conduct literature reviews to understand issues, making it easier for them to recall and comprehend concepts gained through group investigation. Additionally, some students excelling in cognitive domain C4 compared to C2 and C3 indicate a focus on analytical practice, resulting in a dominance of analytical skills with lower comprehension abilities.

CONCLUSION

Based on the outlined research findings, it can be concluded that the physics learning outcomes of students at MAN 1 Makassar, after being taught using problem-based learning, fall within the high category, with an average score of 13.51. Regarding the percentage scores in cognitive domains, the highest percentage of correct responses from students is observed in the understanding domain (C2), while the lowest is in the analysis domain (C4).

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