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Implementation of Interactive Learning Multimedia (ILM) to Improve Physics Learning Outcomes of Grade XI Science Students at MAN 2 Semarang

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Abstract – Physics is often perceived as a difficult subject due to the numerous formulas that students feel they need to memorize. Teaching physics solely through lectures makes it challenging for students at MAN 2 Semarang to grasp the concepts, especially with abstract topics like optical instruments. This is evident in the low average scores on daily quizzes for this material, which are below 60%. This low achievement stems from a lack of learning media and limited student interaction during the learning process. Therefore, this Classroom Action Research implemented Interactive Learning Media for the optical instruments unit to improve student learning outcomes. Interactive Learning Media was chosen because it engages multiple senses through text, images, narration, videos, and animations. These advantages make it easier for students to understand physics concepts and increase their interest in learning. The research results show an improvement in science learning outcomes for students at MAN 2 Semarang on the topic of optical instruments, with average scores increasing from 68 in Cycle I to 76 in Cycle II.

Keywords: Multimedia, learning outcomes, Classroom Action Research

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Introduction

Physics, as a branch of science, is the study of nature. Therefore, Physics should be taught contextually, with approaches that relate to everyday life (Novitasari et al., 2017). Physics learning has factual, conceptual, procedural, and metacognitive characteristics. A variety of learning methods are required in accordance with the characteristics of the subject matter being taught; relying solely on the lecture method makes it difficult for students to imagine or concretize concepts, resulting in weak conceptual understanding. Physics is also often perceived as a subject consisting of a series of formulas that must be memorized. This perception is further reinforced when the teacher's delivery is rigid or intimidating, making Physics a daunting subject for students. Consequently, Physics lessons that contain many scientific concepts must be delivered using various teaching aids and learning media that can "concretize" Physics concepts so they are easier for students to understand (Peranti et al., 2019).

The low learning outcomes in Physics among students are caused by several factors, including ineffective learning methods, a lack of engaging learning media, and limited interaction between teachers and students. The dominance of the lecture method makes students passive and less involved in the learning process. In addition, the minimal use of learning media makes it difficult for students to visualize abstract concepts in Physics. This condition is exacerbated by

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the lack of interaction between teachers and students, so students have limited opportunities to ask questions and discuss material they do not yet understand (Dasmo et al., 2020; Nurmadianti, 2021).

One Physics topic that requires comprehensive understanding is optical instruments, with subtopics including the eye, magnifying glass, microscope, and telescope. Optical instruments are devices that use lenses and mirrors by utilizing the properties of light—reflection and refraction—to aid vision. Optical instruments are classified into two types: natural optical instruments, namely the eye, and artificial optical instruments such as glasses, magnifying lenses, microscopes, and telescopes. This topic requires interactive and concrete instruction. Limitations in equipment and the lack of learning media reduce students' understanding. Daily test results on optical instruments show that students' conceptual understanding is below 60%. The minimal use of media and limited interaction contribute to suboptimal learning outcomes. To address these limitations, a virtual medium is needed to help students correctly understand the concepts of optical instruments. Such media must be able to visualize abstract Physics concepts. One innovation that can be implemented is the use of Interactive Learning Multimedia (ILM).

The use of Interactive Learning Multimedia (ILM) is one alternative for improving students' learning outcomes. ILM offers various attractive features such as animations, videos, simulations, and games that can visualize abstract concepts and increase students' interest in learning. Several previous studies have shown that the implementation of ILM can enhance conceptual understanding, increase learning motivation, and improve students' learning outcomes in various subjects, including Physics. Interactive Learning Multimedia (ILM) has both advantages and disadvantages. According to Rahmawati (2022) and Sari (2024), the advantages of learning multimedia include: (a) enlarging very small objects that cannot be seen by the naked eye, such as germs, bacteria, electrons, and others; (b) reducing very large objects that cannot possibly be brought into schools, such as elephants, houses, mountains, and others; (c) presenting complex, complicated objects or events that occur very quickly or very slowly, such as the human body system, the operation of a machine, the orbit of the planet Mars, the blooming of flowers, and others; (d) presenting distant objects or events, such as the moon, stars, snow, and others; (e) presenting dangerous objects or events, such as volcanic eruptions, tigers, poisons, and others; and (f) increasing students' attraction and attention.

This study examines the implementation of ILM in teaching optical instruments to Grade XI science students at MAN 2 Semarang. The study is motivated by the low Physics learning outcomes of students on this topic and the potential of ILM to improve conceptual understanding and students' interest in learning. The context of this research is Physics learning in Grade XI science classes at MAN 2 Semarang, with the research subjects being the students of that class.

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The urgency of this study lies in the importance of improving students' Physics learning outcomes. Physics is one of the fundamental subjects that students need to master as preparation for continuing their education to higher levels. Improving Physics learning outcomes is also expected to increase students' interest in science and technology.

Based on the explanation above, this study aims to improve the Physics learning outcomes of Grade XI science students at MAN 2 Semarang on the topic of optical instruments through the implementation of interactive learning multimedia. It is expected that through the application of ILM, students will be able to understand Physics concepts more easily, be more active in the learning process, and ultimately achieve better learning outcomes.

Methods

This study was conducted at MAN 2 Semarang, located on Jalan Kelurahan Desa Tengaran, Tengaran District, Semarang Regency. The research subjects were 30 students of Class XI MIPA 1 in the 2020/2021 academic year. The factor examined in this study was students' understanding of Physics concepts, which was measured through learning achievement based on daily test results.

This research employed Classroom Action Research (CAR), adapted from the Hopkins model (Aqib, 2007). The Classroom Action Research was carried out in two cycles, which are systematically illustrated in the research flow shown in Figure 1.

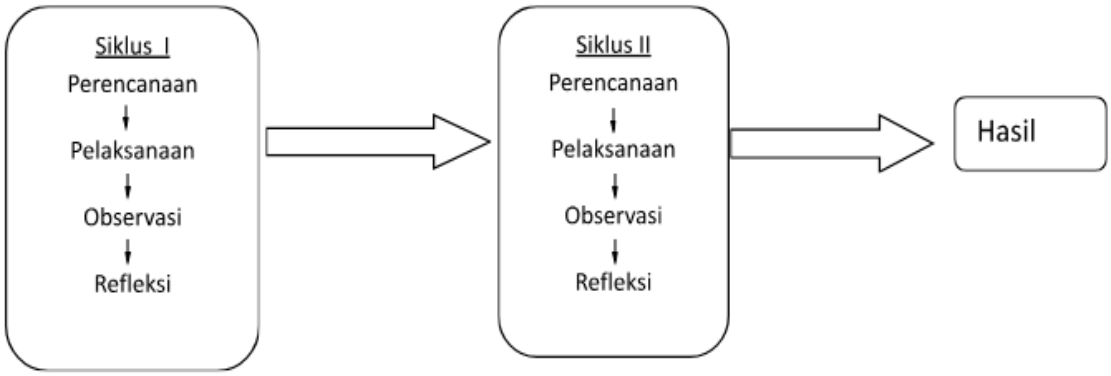

Figure 1. Research Flow

The data collection technique used in this study was a test technique, namely multiple-choice questions. Meanwhile, data analysis employed quantitative descriptive analysis based on the results of students' learning tests on the topic of optical instruments.

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Result and Discussion

A. Research Results

The research results are based on the cycles of Classroom Action Research, namely Cycle I followed by Cycle II, which include students' learning outcomes through the use of Interactive Learning Multimedia (ILM) at the end of each cycle. Table 1 presents the descriptive data for Cycle I and Cycle II.

Table 1. Descriptive Analysis Results of Students

No	Criteria	Cycle I	Cycle II
1	Number of Students	30	30
2	Minimum Score	52	64
3	Maximum Score	83	88
4	Average Learning Outcome Score	68	76

Based on the descriptive analysis results in Table 1, students' learning outcomes showed an improvement from Cycle I to Cycle II with a total of 30 research subjects. In Cycle I, the minimum score was 52, which increased to 64 in Cycle II. This increase in the minimum score indicates that the intervention had a positive impact on students who previously experienced difficulties in understanding the material. It suggests an improvement in the basic understanding of students who were initially left behind. The maximum score also increased, from 83 in Cycle I to 88 in Cycle II. Although the increase was not as large as that of the minimum score, it still indicates progress among students who already had a good level of understanding. The intervention appears to have successfully encouraged these students to reach a higher level of conceptual mastery.

The average students' learning outcome scores after the implementation of ILM in Cycle I and Cycle II are presented in Figure 2.

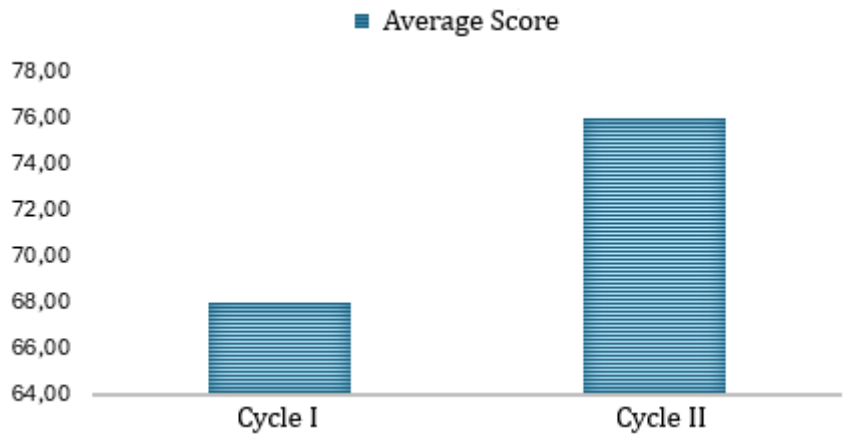

Figure 2. Average Score of Cycle I and Cycle II

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Based on Figure 1, the average learning outcome score showed a fairly significant increase, from 68 in Cycle I to 76 in Cycle II. This improvement strengthens the indication that the intervention was effective in enhancing students' overall understanding. These results are in line with the findings of Sari (2021) regarding the implementation of ILM in the Flipped Classroom teaching model, where classical mastery increased from 41.67% before the intervention to 83.33% after the use of ILM in Cycle I and further to 97.2% in Cycle II. Similar results were also reported by Oktaviani et al. (2024), who found that innovative learning models using multimedia can increase students' interest and learning outcomes.

B. Discussion

According to Munir (2013), the advantages of using interactive multimedia in learning include: (a) a more innovative and interactive learning system; (b) educators are continuously encouraged to be creatively innovative in seeking breakthroughs in learning; (c) the ability to integrate text, images, audio, music, animations, or videos into a unified and mutually supportive whole to achieve learning objectives; (d) increased student motivation during the teaching and learning process, leading to the attainment of desired learning outcomes; (e) the ability to visualize material that has been difficult to explain using only verbal explanations or conventional teaching aids; and (f) training students to become more independent in acquiring knowledge.

The learning process using ILM begins with determining the material to be delivered. Physics material for Grade XI in the second semester includes traveling waves, standing waves, sound waves, light waves, optical instruments, and global warming. The teacher selected the topic of optical instruments because it discusses the path of light rays in the image formation process of optical instruments such as the eye and the microscope, which requires visualization rather than merely listening to the teacher's explanations. The next stage involved previewing the ILM to be used. The teacher did not develop the ILM program independently but collaborated with the Central Java Education and Information Technology Development Agency (BPTIK Dikbud Jawa Tengah) as the content creator on the Jateng Pintar educational website. The trial was conducted on the teacher's laptop by testing and accessing all features of the ILM. These features included apperception, competencies and indicators, learning materials, evaluation, and character education values. After the checking process was completed, the Interactive Learning Multimedia (ILM) on the topic of optical instruments was ready to be used in Physics learning (Qurosyiyah, 2018; Kurnianti et al., 2024).

The process continued with checking the readiness of facilities and infrastructure, including computers and the required software. The teacher coordinated with the ICT teacher, who also serves as the head of the computer laboratory at MAN 2 Semarang. This stage was carried out two days before the lesson to ensure that the Physics learning process would run smoothly. Preparations included checking the condition of the computers, installing Flash software, and

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copying the ILM program from the Jateng Pintar educational website. Schedule coordination was also conducted, considering that there is only one computer laboratory available.

When the Physics lesson began, the teacher asked the students to go to the computer laboratory. The teacher opened the lesson with a prayer and then explained the learning objectives for that day. The students were instructed to turn on the computers in front of them. After all computers were ready, the teacher guided the students to access the ILM program that had been installed on each computer.

During the learning process, students appeared enthusiastic, as evidenced by the calm and focused classroom atmosphere. Students interacted more with the media displayed on their computer screens. The teacher mainly supervised and assisted students who experienced difficulties in operating the computers. Handling any program errors also became the teacher's responsibility. The implementation of learning using ILM was conducted over four lesson hours across two meetings. The first meeting discussed the topics of the eye and the magnifying glass. The eye topic covered the parts of the eye, the process of vision, types of eye defects and how to overcome them. Information about types of eyeglasses, contact lenses, and LASIK laser surgery was also presented. The magnifying glass topic focused more on the image formation process and the two types of magnification. At the end of the first meeting, an evaluation (test) was conducted, and the results showed that the average score was 68, representing a 13% increase compared to before the use of ILM in learning. This finding is supported by the study of Kurniawan et al. (2024), which found that interactive learning media using Canva are quite effective in improving students' learning outcomes in IPAS.

Cycle II discussed microscopes and telescopes. The material included the functions of these optical instruments, the image formation process, image characteristics, and magnification with maximum accommodation or without accommodation. After the time allocated for accessing the material and practicing problems was completed, students were given an evaluation. The assessment for the Optical Instruments chapter was integrated into the system, so the teacher did not need to prepare and distribute test questions. The time taken to complete the evaluation varied among students. The teacher supervised the students to ensure that they did not collaborate with their peers. The teacher then approached students who had finished the evaluation in the ILM and recorded the scores obtained by the students in the grade list.

The learning outcomes of Grade XI MIPA 1 students on the daily test of the Optical Instruments chapter after the second cycle showed an average score of 76. The level of achievement of the Minimum Mastery Criteria (KKM) increased by 26% compared to the initial learning outcomes obtained through the lecture method. In the following meeting, students were given a questionnaire to measure their level of conceptual understanding of Physics in the Optical Instruments chapter. A total of 10 questions were presented to assess students' conceptual

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understanding. The questionnaire results indicated that 80% of the students agreed that the use of Interactive Learning Multimedia (ILM) in teaching the Optical Instruments chapter was able to improve their understanding of the Physics concepts being taught. These findings are supported by the study of Herianto et al. (2017), which reported that interactive science learning multimedia based on Lectora Inspired was effective in improving students' learning outcomes.

Several obstacles were encountered during the implementation of ILM-based learning, particularly the limited number of computers available at the madrasah, since ILM is a computer-assisted program supported by Macromedia Flash software. Consequently, Physics learning using ILM had to be conducted in the computer laboratory. The number of students in Class XI MIPA 1 was 30, while only 28 computers were available. Another constraint was time management. Conducting lessons in the computer laboratory required the teacher to synchronize the Physics lesson schedule with the laboratory usage schedule. Additional time was also needed to prepare the software on the computers and for students to move from the classroom to the computer laboratory. This issue was compounded by the physical distance between locations, as Class XI MIPA 1 was located in the East Building, while the computer laboratory was situated in the West Building of MAN 2 Semarang.

To overcome these constraints, additional computers were temporarily provided by borrowing laptops from teachers. The addition of two laptops increased the total number of available devices to match the number of students, enabling one computer to be used by each student. As a result, the learning process could be carried out simultaneously without

Conclusion and Recommendations

The conclusion of this study is that the learning model using Interactive Learning Multimedia (ILM) that can improve students' conceptual understanding of Physics is a computer-assisted interactive multimedia program for the Optical Instruments chapter obtained from the Jateng Pintar educational website. Physics learning using Interactive Learning Multimedia (ILM) was proven to improve Physics learning outcomes for Grade XI MIPA 1 students at MAN 2 Semarang in the 2021/2022 academic year. Furthermore, ILM-based learning can be applied to other Physics topics, particularly those that require animations to visualize or concretize abstract concepts.

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