



Exploring Innovative Approaches and Evaluation Techniques in Physics Education at Madrasah Aliyah Negeri

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Abstract. Fundamental scientific concepts are integral to our daily lives, influencing decision-making and problem-solving, spanning from the intricate principles of physics governing everyday motions to the biological processes affecting health. This qualitative research delves into the teaching and assessment methods employed in physics education at Madrasah Aliyah Negeri (MAN). The study involves 10 physics teachers selected through purposive sampling, with data collected via Zoom interviews and analyzed using ATLAS.ti 9 software. Findings reveal prevalent teaching methods, such as lectures, discussions, and experiments, with some teachers intertwining physics concepts with Quranic references to sustain student interest. Common assessment methods include written exams and daily quizzes, exhibiting variations based on teacher capabilities and resource availability. Notably, there is a tendency among teachers to emphasize cognitive aspects over affective and psychomotor aspects in assessments. The study proposes solutions to enhance teacher efficacy, advocating targeted curriculum improvements, innovative teaching methodologies, specialized training programs, and a supportive professional environment at MAN. These initiatives aim to elevate the overall quality of physics education, ensuring teachers can effectively leverage the research insights for improved teaching practices.

Keywords: Assessment, Method, Physics, Madrasah Aliyah Negeri.

1 Introduction

Physics is seen as a tough subject in Islamic Senior High Schools because it involves grasping abstract and complex ideas and applying them in everyday situations, which can be challenging for many students. [1], [2], [3]. Therefore, the use of appropriate teaching methods and effective assessment is crucial in facilitating students' understanding of physics concepts [4]. Despite its importance, the learning outcomes in physics in Islamic Senior High Schools are still low, as evidenced by the National Examination results which show that the pass rate for physics is below the national average. Therefore, there is a need for analysis of physics teaching methods and evaluation of physics learning in Islamic Senior High Schools to improve the quality of students' learning outcomes in physics. Currently, there is no in-depth research on physics teaching methods and evaluation in Islamic Senior High Schools.

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In the learning process, methods and assessments are pivotal stages, particularly within the realm of physics education in Madrasah Aliyah Negeri (MAN). The term Madrasah Aliyah Negeri (MAN) denotes Islamic Senior High Schools in Indonesia, where these institutions concentrate on providing education at the senior high school level with a specific emphasis on Islamic studies. This undertaking serves as a strategic measure aimed at enhancing the quality of measurable and competitive learning outcomes. [5]. The position of methods and assessment is crucial for the fulfilment of the main task of carrying out learning [6].

Several studies have been conducted on the methods and evaluation of physics education in Madrasah Aliyah Negeri [7]–[9]. However, most of these studies focus more on physics teaching methods, such as the use of learning media and innovative teaching methods, without comprehensively analyzing physics learning evaluation. This study focuses on two key aspects to offer a more complete understanding of physics learning practices in Madrasah Aliyah Negeri (MAN). It specifically explores the relationship between teaching methods and physics learning evaluation and their impact on student learning outcomes.

The novelty of this research lies in its comprehensive examination of physics learning and evaluation methods in MAN. By delving into the specifics of these methods and their correlation with student outcomes, the study aims to provide valuable insights for the development of the physics curriculum and learning practices in MAN. The research also contributes to the broader understanding of physics learning theories, especially within the context of Madrasah Aliyah Negeri, with the goal of enhancing physics education.

2 Method

This research uses a qualitative research approach with a descriptive method [10], [11]. The researcher used a qualitative descriptive research design because it is appropriate for the research needs, which aim to narrate and describe data about processes that have taken place and whether they match what was reported and observed in the field or the opposite [12].

The research involved 10 physics teachers teaching at Madrasah Aliyah Negeri in South Sulawesi Province as purposive sampling informants. This indicates that there are 10 teachers involved in the study, and each teacher is assigned a code for identification, ranging from P1 to P10. The criteria for selecting physics teachers as informants were: 1) having a minimum of 2 years of teaching experience at Madrasah Aliyah Negeri, and 2) having participated in training on assessment instrument development/construction, either conducted by their school or similar agencies. The data collection method in this study was interviews conducted through the Zoom Meeting platform. The research was conducted by the researcher throughout January 2023, adjusted to the informants' availability. The average duration of each interview was between 40 to 50 minutes.

According to Miles & Huberman qualitative analysis technique is conducted in three stages. The first stage is to transcribe interview results, coding, classifying coding, and linking the meaning of each coding based on relevant themes. The second stage is data reduction, data presentation, and conclusion drawing. After the data is

simplified, it is then grouped according to similarity of aspects and themes. The third stage is to determine the connection between these themes to gain a deeper understanding. The results of the analysis are then used to draw conclusions about the implementation of learning assessment in the subject of physics. All data analysis activities are conducted using ATLAS.ti 9 software.

3 Results and Discussion

3.1 Physics Learning Methods

There are seven forms of learning methods that are commonly used by teachers in teaching physics during research studies: PBL and Discovery, Discussion, Lectures, Watch Videos, Record, Motivation, and Reduce Formulas (See Figure 1).

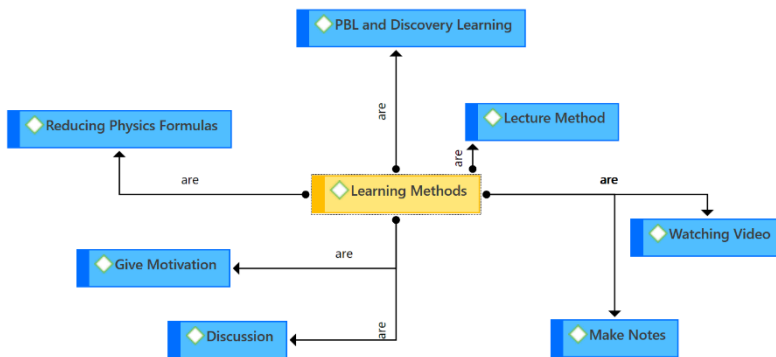


Fig. 1. Physics learning methods.

PBL dan Discovery Learning Models. Problem-based learning (PBL) and Discovery are described as good learning methods in teaching physics. Problem-Based Learning is a method that encourages students to actively learn and discover knowledge on their own. Meanwhile, Discovery learning is a method that encourages students to actively discover knowledge on their own. P3 said, “I have tried using discovery learning, PBL, and STEM methods. I once tried using the STEM method for the material of light waves through virtual labs, but it took a long time. I also provided knowledge in the lab, although it took a long time.” From this, it is known that the teacher has tried various effective learning methods in teaching physics, including the discovery, PBL, and STEM methods, but the STEM method takes a long time and is therefore less effective.

The same thing is said by P1 that, “I teach physics by emphasizing the material that they can observe in daily life. I usually teach physics by informing students about the purpose and function of the material to be learned. For example, the material of significant figures. This material can be used, for example, when weighing gold. If you don't understand the rules of significant figures, the seller or buyer may lose money.” From this statement, it is known that the teacher tries to make students

interested in learning physics by explaining to them the benefits of learning physics for everyday life.

Discussion. This method starts with providing the material orally first. Then, at the end of the session, there is a task distribution for everyone or group. P6 said, “Before the pandemic, I used the information discussion method by giving a prologue to convey the material, then while I wrote down the information on the blackboard, both the theory and formulas.” From this statement, it is known that before starting the discussion, the teacher first provides an explanation of important things that students need to know as initial knowledge. Similarly, the discussion method can also make students more focused on learning, as stated by P5, “For example, when students are less focused, I use the discussion method so that students can focus again.” It can be concluded from this statement that the discussion method can make every student active in learning so that everyone can be more focused on the material being studied.

Learning Methods. The lecture is a teaching methodology where the delivery of learning information to students is done orally. P1, P4, and P8 stated that they provide sample questions along with their answers by explaining the step-by-step solution. After that, I explain the relationship of the concepts of physics material that I have described with the facts in the Quran or Hadith. From these statements, it can be concluded that by using this method, the lesson can be controlled by the teacher by providing information related to the concept of material systematically, so that physics learning can run effectively and smoothly while being related to Islamic values.

Watching Video. The learning method that uses videos is to play a pre-recorded instructional video to assist in the learning process. P8 said, “I also make my own videos for learning because students don't understand if the videos provided are from YouTube.” From this statement, it can be concluded that watching videos will make it easier for students to understand the material.

Make Notes. The note-taking method referred to here is the process of summarizing and organizing notes related to the material that has been explained by the teacher so that the taught material is not easily forgotten by the students. P9 said, “That's why I tell them to take notes so that if they forget, I can immediately tell them to look at their notes.” From this statement, it can be concluded that with the existence of notes, students can easily remember or review the material they have learned before.

Give Motivation. Giving motivation refers to providing encouragement to students to achieve understanding of the subject matter or to develop their learning skills. P7 said, “I emphasize that physics is easy and fun, so students start to become interested in learning it because currently physics is considered difficult and scary.” From this statement, it is known that the teacher instills understanding and motivation to the students that physics is an easy and enjoyable subject. This is aimed at making students enjoy learning physics. However, it cannot be denied that every individual

inherently has different learning motivations. This was conveyed by P10 that, “In general, the students' motivation in learning physics is quite good, although it cannot be denied that there are some students who are lazy and less motivated to learn physics.” From this statement, it is known that not all students have the same motivation in learning physics.

Simplifying Physics Formulas. The reduction of formulas referred to here is the simplification of physics formulas into simpler ones that are easily understood by students. P10 said, “To overcome the material obstacles, I minimize the use of formulas by emphasizing on the reasoning of science.” From this statement, it can be concluded that physics is no longer taught by emphasizing formulas that can make students difficult to understand the material. Instead, the concept of the material is taught through the reasoning of scientific concepts in everyday life.

3.2 Difficulties in Teaching Physics

There are seven forms of obstacles experienced by teachers in teaching physics during research studies: student memory, mathematical ability, complicated physics material, understanding physics formulas, critical thinking skills, cheating habits, student complaints (see figure 2).

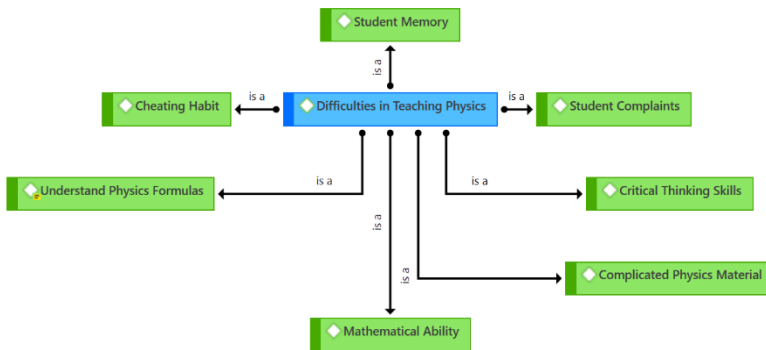


Fig. 2. Difficulties in teaching physics

Student Memory. The student’s memory referred to here is the weak memory of students on physics material, which easily disappears after being taught before. P2 said, “Almost every meeting, I have to teach the same material repeatedly. What happens is that if I teach them now, they understand, but when they leave the class, they forget.” From this statement, it can be concluded that, basically, the students' memory on physics material is quite weak, which affects the lack of mastery and understanding of the physics material.

Mathematical Ability. The math ability referred to here is the ability of students to use and interpret mathematics in various contexts, including mathematically reasoning and using mathematical concepts, procedures, facts, and tools to explain physics concepts. P1 stated that “the common obstacle faced in teaching physics is that students are very difficult in calculations. Students do not understand basic math operations such as addition or multiplication. So, when I teach physics, I must teach math first because students' math ability is very poor. This causes my lessons to be delayed”. From this statement, it can be inferred that students’ basic math skills, particularly in number operations such as addition or multiplication, are lacking. This results in the delay of the subject matter because the teacher must teach math to students before teaching physics. Similarly, P8 said that students do not understand basic math operations such as division or multiplication. From this statement, it can be inferred that the basic math operations that students lack are division or multiplication. In addition, P6 stated that “the material that is difficult for students to understand is the material that requires lengthy mathematical calculations. Because students are already confused with physics formulas or equations”. From this statement, it can be concluded that complex problems or materials that use complicated mathematical operations make students confused, so they will have difficulty understanding the physics material or solving the physics problems.

Complicated Physics Material. Complicated physics material refers to the complexity or characteristics of physics material that requires scientific reasoning to understand. P9 said, “The material that is considered difficult to teach and understand by students is the material that requires conceptual reasoning. Because to understand the material, students must understand the basic concepts of the material.” From this statement, it can be concluded that physics material is quite complicated because it requires conceptual reasoning. So, the teacher must be involved in guiding students to understand the concepts of physics.

Understanding Physics Formulas. Understanding physics formulas referred to here means understanding the symbols, notations, units, and explanations of each symbol and notation, along with the usage function of each physics formula. P4 said, “In addition, in this subject there are many formulas, symbols, and things that make it difficult for them to understand physics.” From this statement, it can be concluded that physics has many formulas and symbols that make it difficult for students to understand.

Critical Thinking Ability. The critical thinking ability referred to here is the students’ ability to obtain information, collect data, and evaluate findings effectively. P3 said, “In general, students’ abilities are still at a moderate level, meaning that some students like to learn physics, but there are also students who are less interested in learning physics.” From this statement, it can be concluded that students are divided into two ability groups. For students with moderate and high abilities, they will be more interested in learning physics, while students with low abilities will be less interested in learning physics.

Cheating Habits. The cheating habit referred to here is a dishonest and unethical way of using any means necessary to achieve the best possible grade in completing assignments, especially during exams. P5 said, “It’s difficult to identify because I have trouble detecting students taking tests or working on assignments. Some students are caught discussing and sharing answers.” From this statement, it can be concluded that students' lack of effort in learning physics may be due to their tendency to cheat during exams. This behavior leads students to develop unhealthy habits in achieving the competencies they are supposed to acquire.

Student Complaints. The students’ complaints referred to here are the views of the students regarding the excessive demands of the lessons. They are required to master many subjects. P1 said, “Students sometimes protest about the amount of material they have to learn, while teachers only teach one subject.” From this statement, it can be concluded that students also complain about the heavy demands of the curriculum, which sometimes leads them to complain about it.

3.3 Forms of Physics Learning Assessment

There are four forms of assessment commonly used by teachers in physics learning during research studies: affective assessment, essay questions, uniform questions, practice questions (see figure 3).

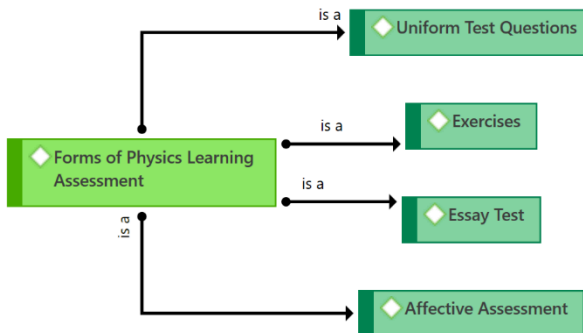


Fig. 3. Forms of physics learning assessment

Affective Assessment. The affective assessment referred to here is an assessment that includes behavioral characteristics, such as attitudes, feelings, emotions, interests, and values. P7 said, “In the affective assessment, if a student misses more than two classes, I deduct their grade.” From this statement, it can be inferred that affective assessment is used by the teacher to assess student attendance in learning.

Essay Test. The essay questions referred to here are questions that require students to answer in the form of elaboration, explanation, discussion, comparison, giving

reasons, and other similar forms according to the demands of the question using their own words and language. P2 said, “The form of the questions given is essay with 2 quiz questions, 5 midterm questions, and 8 final exam questions.” From this statement, it is known that essay questions are used by teachers in various types of assessments. In addition, essay questions are more able to reveal students' abilities than other types of questions, as stated by P3 that “The questions used to assess students are more essay-based because they are more capable of revealing students' abilities than multiple choice questions.” From this statement, it can be inferred that essay questions are better than multiple choice questions for physics lessons. From this statement, it can be concluded that essay questions will minimize the opportunity for students to collaborate during exams and encourage students to think objectively in answering questions.

Uniform Test Questions. The uniform questions referred to here are questions given to students that have the same form and format for all types of abilities. P9 said, “Giving uniform questions to all students.” From this statement, it can be inferred that the questions given to all students have the same form. This is in line with what P5 said, “The questions given are uniform for all students. The aim is to measure their abilities, and I do not have difficulty checking the questions. If the questions are diverse, I will have difficulty checking the students' answers.” From this statement, it can be concluded that the purpose of giving uniform questions is to enable the teacher to easily differentiate each student's ability and to make it easier for the teacher to check the questions.

Exercises. The exercises referred to here are activities that can help students identify which material they have mastered and which they have not. Exercises can also help students focus more on learning the materials they want to master. In addition, exercises serve as a means of practice for students in preparing themselves for exams. P4 said, “Exercises are my main reference for assessing students' abilities.” From this statement, it can be inferred that by using exercises, the teacher can easily monitor students' progress in learning physics. Similarly, P3 said, “To assess learning outcomes, we use task assessments, note grades, quiz grades, mid-semester exams, and final exams.” From this statement, it can be concluded that the teacher uses various types and forms of assessment to evaluate students' abilities.

The research results show that there are seven teaching methods used by physics teachers to teach physics material. These methods are problem-based learning (PBL) and discovery, discussion, lecture, watching videos, note-taking, motivating, and reducing formulas. The PBL and discovery methods can support active participation of students in the learning process and stimulate their curiosity to build knowledge based on their prior knowledge, so that they can have a deeper understanding [14], [15].

In addition, this study revealed seven obstacles faced by physics teachers in teaching the subject. Students think that the physics subject has more topics and concepts than necessary, and that the subject is boring. Additionally, students have a bias that the course is difficult, and they get this feeling from their environment [9].

Based on these findings, it can be assumed that the content of physics courses and textbooks are not organized according to the students' real-life experiences. Students face physics topics with the name 'physics' for the first time when they start middle school. Before middle school, students study these topics in science classes along with other science fields.

4 Conclusion

Based on the research findings, it can be concluded that there are seven learning methods commonly used by teachers in teaching physics, namely PBL and discovery methods, discussions, lectures, watching videos, note-taking, providing motivation, and reducing formulas. In addition, there are also seven obstacles experienced by teachers in teaching physics, namely students' memory, mathematical abilities, complex physics material, understanding physics formulas, critical thinking skills, cheating habits, and student complaints. Regardless of that, there are four types of assessments commonly used by teachers in teaching physics, namely affective assessment, essay questions, uniform questions, and exercises. Teachers should also be able to overcome all the obstacles experienced by students and prepare appropriate assessments to measure students' abilities. Therefore, the research results can provide clearer and more useful recommendations for curriculum development and improving the quality of physics learning in schools in Indonesia.

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