EVALUATING THE IMPACT OF CASE-BASED TEACHING MATERIALS IN PHYSICS TOWARDS OBE CURRICULUM

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ABSTRAK

Bahan ajar memainkan peran penting dalam pendidikan, berfungsi sebagai sumber daya dan panduan penting bagi guru dan siswa. Bahan ajar secara signifikan meningkatkan pemahaman dan pengembangan kompetensi siswa dengan menyelaraskannya dengan tuntutan kurikulum, khususnya kompetensi berbasis keterampilan. Keterampilan proses sains sangat penting untuk melibatkan siswa dalam Fisika, namun metode pengajaran tradisional sering kali membatasi pengembangan keterampilan ini. Pendidikan Fisika yang efektif harus menggabungkan berbagai strategi, termasuk pendekatan studi kasus, yang menumbuhkan pemikiran ilmiah, kreativitas, dan keterampilan memecahkan masalah. Menerapkan pendekatan ilmiah dapat lebih meningkatkan keterampilan ini tetapi dapat menimbulkan tantangan seperti kecepatan belajar dan minat siswa yang berkurang. Guru harus mengatasi tantangan ini melalui pemantauan ketat dan persiapan menyeluruh, memastikan bahan ajar valid dan efektif. Peneliti mengusulkan untuk mengintegrasikan metode berbasis kasus dengan pendekatan ilmiah untuk membantu siswa dalam mempelajari fenomena gelombang, membuat konsep Fisika lebih mudah diakses. Efektivitas bahan ajar ini akan dievaluasi menggunakan uji N-Gain, ukuran statistik yang menilai peningkatan kinerja siswa melalui desain pra-tes-pasca-tes kuasi-eksperimental, dengan data dianalisis menggunakan SPSS. Studi ini bertujuan untuk mengidentifikasi masalah dan mengumpulkan umpan balik pengguna untuk mengoptimalkan bahan ajar Fisika. Analisis bahan ajar yang dikembangkan dengan menggunakan metode kasus, didukung oleh pendekatan ilmiah, menunjukkan keefektifannya dalam meningkatkan keterampilan proses sains siswa. Nilai rata-rata N-Gain sebesar 0,71, mencerminkan peningkatan sebesar 71%, bahan ajar ini secara signifikan meningkatkan kemampuan siswa, khususnya dalam mata pelajaran Gelombang Bunyi. Keefektifannya terlihat dari peningkatan keterampilan analisis dan pemecahan masalah di kalangan siswa, yang divalidasi melalui perbandingan pra-tes dan pasca-tes. Nilai rata-rata pra-tes adalah 60,4, yang meningkat menjadi 88,3 pada pasca-tes. Meskipun terdapat beberapa tantangan seperti akses internet yang tidak konsisten, bahan ajar terbukti sangat efektif, dengan 20 siswa mencapai hasil yang efektif dan 10 siswa mencapai hasil yang cukup efektif. Bahan ajar juga menumbuhkan berbagai keterampilan proses sains termasuk berpikir kritis, eksperimen, dan komunikasi. Metode-metode ini mendorong keterlibatan siswa, berpikir kritis, kolaborasi, penerapan di dunia nyata, kreativitas, dan mengatasi hambatan belajar, menjadikan pendidikan lebih dinamis dan interaktif.

Kata Kunci: Metode Kasus; Pendekatan Ilmiah; Keterampilan Proses Sains; Bahan Ajar Nilai N-Gain

ABSTRACT

Teaching materials play an essential role in education, serving as critical resources and guides for both teachers and students. They significantly enhance students' understanding and competency development by aligning with curriculum demands, particularly skill-based competencies. Science process skills are vital for engaging students in Physics, yet traditional teaching methods often limit the development of these skills. Effective Physics education should incorporate diverse strategies, including the case study approach, which fosters scientific thinking, creativity, and problem-solving skills. Implementing a scientific approach can further enhance these skills but may present challenges such as reduced

learning pace and student interest. Teachers must address these challenges through close monitoring and thorough preparation, ensuring teaching materials are valid and effective. Researchers propose integrating case-based methods with a scientific approach to aid students in learning wave phenomena, making Physics concepts more accessible. The effectiveness of these materials will be evaluated using the N-Gain test, a statistical measure assessing improvement in student performance through a quasi-experimental pretest-posttest design, with data analyzed using SPSS. This study aims to identify issues and gather user feedback to optimize Physics teaching materials. The analysis of teaching materials developed using the case method, supported by a scientific approach, reveals their effectiveness in enhancing students' science process skills. The average N-Gain score of 0.71, reflects a 71% improvement, these materials significantly improve students' abilities, particularly in the Sound Wave subject. The effectiveness is evident in the enhanced skills of analysis and problem-solving among students, validated through pre-test and post-test comparisons. The average pre-test score was 60.4, which increased to 88.3 in the post-test. Despite some challenges such as inconsistent internet access, the teaching materials proved to be highly effective, with 20 students achieving effective results and 10 achieving fairly effective results. The teaching materials also foster various science process skills including critical thinking, experimentation, and communication. These methods encourage student engagement, critical thinking, collaboration, real-world application, creativity, and overcoming learning barriers, making education more dynamic and interactive.

Keywords: Case Method; Scientific Approach; Science Process Skills; Teaching Materials N-Gain Score

PENDAHULUAN

Teaching materials play a crucial role in the educational process, serving as essential resources and guides for both teachers and students. These materials significantly enhance students' understanding of lessons and aid in their competency development. Teaching materials are designed to align with the curriculum's demands, ensuring they support core competencies, particularly skill-based competencies. (Esteban-Yago et al., 2023; Ramdani et al., 2021; Setyo et al., 2023). Such competencies are invaluable as they offer practical learning experiences to students, including the development of science process skills.

Science process skills are instrumental in making students more engaged and interested in learning Physics. Teachers who emphasize these skills can create more focused and effective lessons. However, Physics education often remains dominated by traditional methods of explaining concepts and practicing problems, which limits students' ability to develop their science process skills, creativity, and critical thinking abilities. The limited development of students' science process skills is partly due to the prevalent use of the lecture method, which hinders student participation and the exploration of related material. This approach also discourages students from asking questions or sharing their opinions, leading to a passive learning environment (Addae & Quan-Baffour, 2018; Mutende et al., 2021; Umar et al., 2016).

An effective Physics learning process should incorporate strategies that blend various methods, approaches, and supporting media in line with the learning objectives. One effective method is the case study approach, which encourages students to analyze, formulate, and solve problems, fostering scientific thinking and understanding of complex concepts. This method promotes creativity and critical analysis among students. (Lavi & Marti, 2023; Siburian et al., 2019; Wechsler et al., 2018). Additionally, a scientific approach can further enhance students' science process skills. This approach is known to regularly develop problem-solving abilities through various scientific activities. However, implementing the scientific approach can present challenges, such as slowing down the pace of learning and decreasing student interest, potentially leading to ineffective learning outcomes.

Teachers must continually strive to mitigate them. For example, to prevent errors in conclusions, teachers should provide close

monitoring and assistance during the learning process. To manage time effectively and engage students, teachers need to make thorough preparations and use teaching materials that are both valid and effective. In response to these challenges, researchers aim to integrate case-based methods with a scientific approach using specialized teaching materials. These materials are developed to assist students in learning about wave phenomena through scientific processes, making it easier to grasp Physics concepts. The effectiveness of these teaching materials will be evaluated using the N-gain test to ensure they meet educational standards.

METODE PENELITIAN

The N-Gain (Normalized Gain) is a statistical measure used to evaluate the effectiveness of educational interventions. It was used in educational research to assess the improvement in students' understanding or performance after a specific instructional activity. The form of research is a quasi-experiment with a one-group pretest-posttest type. Data analysis in this research was carried out descriptively by determining the residual regression test with the help of the SPSS program. This test is to determine a decision on the hypothesis being tested. This is done to be able to find out the problems faced and user responses to the products offered in Physics learning.

HASIL DAN PEMBAHASAN

The data analysis results presented in Table 1 indicate that the teaching materials developed using the case method fall within the effective category. The overall average N-Gain score is 0.71, equivalent to a 71% improvement. These results demonstrate that the developed teaching materials significantly enhance students' science process skills, particularly in the Sound Wave material. The effectiveness of these case method-based teaching materials, supplemented by a scientific approach, is evident in the improved science process skills of students. (Darmaji et al., 2019; Gizaw & Sota, 2023; Maison et al., 2019; Tan et al., 2020). This improvement is observable through students' enhanced abilities to analyze and solve the cases presented in the teaching materials. The utility of these materials is further validated by student assessments, including case-solving tasks and questionnaires analyzed using the N-Gain equation.

The effectiveness of the teaching materials is measured by comparing pre-test and post-test scores. The average pre-test score was 60.4, while the post-test average increased to 88.3. Among the students, 10 were categorized as achieving fairly effective results, while 20 were in the effective category. Some variations in effectiveness were due to constraints such as inconsistent internet access, which affected the student's ability to fully engage with the teaching materials. Overall, the average N-Gain score of 0.71 reflects a substantial increase in students' science process skills, indicating that the case method-based teaching materials are highly effective in improving these skills (Fig. 1).

Table 1. N-Gain Test Results

Category	N-Gain Score (%)	Total
Effective	74,35	20
Fairly Effective	62,7	10

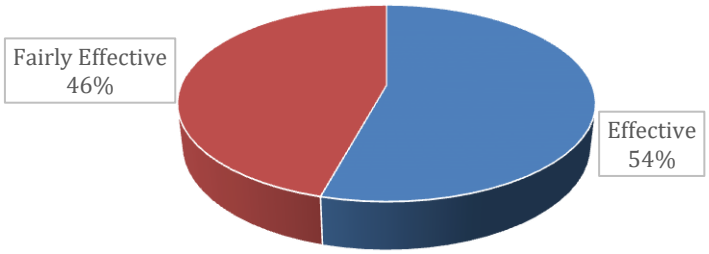

Figure 1. Percentage of effectiveness level

Impact on Science Process Skills Specific Skills Enhanced: 1. Analyzing, Teaching materials designed with the case method encourage students to dissect complex scientific cases into smaller, more manageable parts. This critical analysis helps them identify key components and variables, assess relationships, and draw logical conclusions from data. This skill is essential as it lays the foundation for deeper scientific understanding and methodical thinking; 2. Problem-Solving, The case method empowers students to tackle scientific problems by understanding the problem context, formulating hypotheses, and designing experiments to test these hypotheses. Through this iterative process of evaluation and refinement, students develop robust problem-solving skills. This capability is crucial not only in academic settings but also in real-world scenarios where scientific inquiry is applied; 3. Scientific Thinking, Engaging with case-based scenarios, students adopt a scientific mindset. They learn to develop and use models, engage in arguments supported by evidence, and apply scientific principles to novel situations. This approach nurtures a methodical way of thinking, encouraging students to approach problems regularly and logically; 4. Observation and Data Collection, Accurate observation and data collection are fundamental to scientific inquiry. The teaching materials guide students in recording observations regularly and using appropriate tools for data gathering, ensuring the reliability and validity of their findings. This skill is indispensable for conducting meaningful experiments and investigations; 5. Experimentation, Students are guided to design and conduct experiments, control variables, and analyze results. This hands-on approach reinforces their understanding of scientific concepts and methods. Experimenting, students learn through discovery, which enhances retention and comprehension of scientific principles; 6. Critical Thinking and Reflection, The case method promotes critical thinking by encouraging students to reflect on their findings and the learning process. Students question assumptions, consider alternative explanations, and reflect on their performance to improve future investigations. This continuous process of reflection and adjustment is key to developing a scientific mindset; and 7. Communication, Effective communication is a vital aspect of science. The teaching materials help students articulate their findings and reason clearly. This skill is developed through writing detailed reports, presenting findings, and participating in discussions. Clear communication ensures that scientific knowledge is shared accurately and persuasively. The case method-based teaching materials not only enhance students' understanding of scientific concepts but also prepare them for advanced studies and real-world scientific challenges. This holistic development of skills through practical, hands-on learning makes the teaching materials a valuable educational tool. (Darmaji et al., 2023; Husna et al., 2022; Laurence, 2022; Perez Sierra et al., 2022).

Student Engagement: The case method significantly enhances student engagement by immersing students in real-world scenarios. Analyzing specific cases, students become active participants in their learning journey. They move beyond passive note-taking to actively dissect problems, formulate hypotheses, and explore various solutions. This hands-on involvement naturally stimulates their interest and curiosity,

fostering a deeper connection to the subject matter. Similarly, the scientific approach nurtures engagement through systematic problem-solving activities. Employing steps such as observation, hypothesis formation, experimentation, and conclusion, students experience a structured yet exploratory learning process. This method encourages them to think critically and scientifically, promoting active engagement as they learn through doing.

Enhancing Critical Thinking and Problem-Solving Skills, Both methods emphasize critical thinking and problem-solving, essential skills for academic and real-world success. The case method requires students to identify key issues, analyze information, and develop solutions. This process helps them build analytical skills and think strategically about problems. The scientific approach, on the other hand, involves hypothesis testing, data analysis, and drawing evidence-based conclusions. This approach fosters inquiry and skepticism, which is essential for scientific thinking. Constantly questioning and testing their assumptions, students develop a more rigorous and analytical approach to learning. (Croce et al., 2018; Gómez García & Alba Cabañas, 2022; O'Reilly et al., 2022; Shehzad et al., 2019; Thomas, 2009).

Building Collaboration and Communication, The case method often involves group discussions and collaborative problem-solving. Students must communicate their ideas, defend their solutions, and critique others' viewpoints. This collaborative environment enhances their ability to work in teams, listen actively, and articulate their thoughts clearly. The scientific approach also promotes collaboration, especially during experiments and group projects. Students learn to share responsibilities, discuss their findings, and collectively solve problems. These collaborative experiences help build communication skills and foster a sense of community and shared purpose in the classroom.

Encouraging Real-World Application, The case method brings real-world relevance to the classroom. Working on actual cases, students see the practical application of theoretical concepts. This relevance makes the material more interesting and meaningful, motivating students to engage deeply with the content. The scientific approach also emphasizes real-world application by encouraging students to apply scientific principles to everyday problems. This approach helps them see the relevance of science in their daily lives and inspires a more profound interest in the subject. (Hai Pham, Yen et al., 2023; Huang et al., 2016; Talpaert et al., 2019). Fostering Creativity and Innovation, Both methods encourage creativity and innovation. The case method challenges students to think outside the box and develop unique solutions to complex problems. This creative thinking is crucial for innovation and can inspire students to pursue new ideas and approaches. The scientific approach, with its emphasis on experimentation and hypothesis testing, also fosters a spirit of innovation. Students are encouraged to explore new hypotheses, design experiments, and discover novel insights. This creative process enhances their ability to think scientifically and innovate. Overcoming Learning Barriers and engaging students actively, both methods help overcome common learning barriers. Passive learning often leads to disengagement and superficial understanding. The active involvement required by the case method and the scientific approach ensures that students remain attentive and motivated, leading to better retention and understanding of the material. In conclusion, the case method and scientific approach foster student engagement and active participation by promoting critical thinking, collaboration, real-world application, creativity, and overcoming learning barriers. These methods transform the learning experience from passive to active, making education a dynamic and engaging process.

SIMPULAN

The teaching materials designed using the case method, supplemented by a scientific approach, significantly enhance students' science process skills. Key skills improved include critical analysis, problem-solving, scientific thinking, observation and data collection, experimentation, critical thinking and reflection, and communication. The case method and scientific approach foster student engagement by immersing them in real-world

scenarios and systematic problem-solving activities, thus promoting active learning. These methods also emphasize collaboration and communication, bringing real-world relevance to the classroom, which encourages creativity and innovation. They help overcome common learning barriers by actively involving students, making the educational process dynamic and engaging. Overall, the integration of case-based methods with scientific approaches makes teaching materials valuable tools for enhancing students' scientific competencies and preparing them for advanced studies and real-world challenges. The assessment of the teaching materials, crafted using the case method and enhanced by a scientific approach, highlights their effectiveness in boosting students' science process skills. The average N-Gain score of 0.71, reflecting a 71% improvement, these materials have shown substantial impact, particularly in the Sound Wave subject.

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