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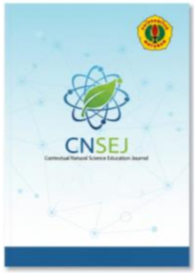

THE INFLUENCE OF EXPERIMENTAL VIDEO MEDIA AND CURIOSITY ON THE UNDERSTANDING OF MECHANICAL CONCEPTS

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ABSTRACT

This study aims to examine the effects of experimental video media and curiosity on students' conceptual understanding of mechanics. The rationale for this research stems from the persistently low level of students' conceptual understanding in mechanics, which is largely attributed to conventional instructional practices and limited opportunities for direct experimental experience. Experimental video media are expected to facilitate the visualization and contextualization of abstract physics concepts, while curiosity functions as an intrinsic motivational factor that encourages active engagement in the learning process. This study employs a quasi-experimental approach with a 2 × 2 factorial design. The sample consists of two classes selected through purposive sampling, and the research instruments include a mechanics conceptual understanding test and a curiosity questionnaire. The findings are expected to demonstrate that both the use of experimental video media and students' curiosity have a positive and significant effect on conceptual understanding of mechanics.

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Introduction

Conceptual understanding is a fundamental objective of physics education, as it directly determines students' ability to apply scientific principles in explaining natural phenomena encountered in everyday life. Physics learning is not merely focused on the acquisition of mathematical formulas; rather, it emphasizes meaningful comprehension of concepts and the relationships among physical variables. According to the revised Bloom's taxonomy, conceptual understanding requires learners to interpret, explain, and integrate knowledge, rather than simply recall information (Anderson & Krathwohl, 2019). Without adequate conceptual understanding, students are likely to develop misconceptions that may hinder their learning of more advanced physics topics.

Mechanics is one of the core domains in physics and serves as a foundational framework for understanding various physical phenomena. Topics such as motion, force, Newton's laws, energy, and momentum form the basis for subsequent learning in other areas of physics. However, numerous studies have reported that students often experience significant difficulties in mastering mechanics concepts due to their abstract nature and the need for high-level reasoning skills (Giancoli, 2015). These difficulties are frequently exacerbated by instructional practices that emphasize procedural problem-solving over conceptual reasoning.

In many classroom settings, physics instruction remains teacher-centered and dominated by lecture-based methods, offering limited opportunities for students to actively engage with physical phenomena. As a result, learning becomes monotonous and disconnected from real-world contexts, reducing students' motivation and curiosity. When students are not encouraged to question, explore, or observe phenomena directly, they tend to rely on rote memorization of formulas without understanding their underlying meaning. This condition contributes to persistent misconceptions and weak conceptual frameworks, particularly in mechanics learning.

One instructional approach that has gained increasing attention in addressing these challenges is the use of experimental video media. Advances in educational technology have enabled the integration of video-based experiments into physics instruction, allowing students to observe phenomena that may be difficult to demonstrate directly due to limitations in equipment, time, or safety (Hafizah, 2020). Experimental videos provide dynamic visualizations that transform abstract concepts into concrete representations, enabling students to repeatedly observe experimental procedures and outcomes. Previous studies have shown that video-based experiments enhance students' conceptual understanding by linking theoretical explanations with observable physical behavior (Al-Hammoud, 2019; Jawil & Hajeriati, 2025).

In addition to instructional media, affective factors—particularly curiosity—play a critical role in learning success. Curiosity is an intrinsic motivation that drives individuals to seek new knowledge, ask questions, and explore causal relationships within phenomena. In physics learning, curiosity encourages students to actively engage with content, challenge existing ideas, and construct deeper conceptual understanding. Harianja (2020) reported that students with high levels of curiosity demonstrate greater independence, persistence, and learning achievement compared to those with lower curiosity. Consequently, fostering curiosity is essential for promoting meaningful and sustained learning in physics.

Importantly, the effectiveness of instructional media such as experimental videos is closely related to students' curiosity levels. Engaging and interactive media have the potential to stimulate curiosity by presenting phenomena that provoke inquiry and cognitive conflict. Studies have indicated that learning environments that integrate visual media and inquiry-oriented approaches are effective in reducing misconceptions and strengthening conceptual relationships in mechanics (Sari & Nana, 2020; Jati et al., 2024). This suggests that conceptual understanding is best developed through the interaction between appropriate learning media and positive affective dispositions.

Based on these considerations, it is evident that improving students' conceptual understanding of mechanics requires a holistic approach that integrates technological instructional media and affective factors. Therefore, this study focuses on examining the effects of experimental video media and curiosity on senior high school students' conceptual understanding of mechanics. By employing a quasi-experimental design with a factorial structure, this research seeks to provide empirical evidence regarding the individual and interactive contributions of instructional media and curiosity in physics learning.

Method

This study employed a quasi-experimental approach, as the researcher did not randomly assign participants but utilized existing classroom groups. The research design applied was a 2 × 2 factorial design, which enabled the examination of the effects of two independent variables learning media and curiosity on the dependent variable, namely students' conceptual understanding of mechanics, as well as the interaction between these independent variables. This design was considered methodologically appropriate for investigating the combined influence of pedagogical and affective factors in physics learning.

The population of this study consisted of senior high school students who were studying mechanics. The sample comprised two classes selected through purposive sampling based on the equivalence of initial abilities, student characteristics, and the suitability of the curriculum and learning materials. One class was assigned as the experimental group and received instruction using experimental video media, while the other class served as the control group and was taught using conventional instructional methods. This grouping was intended to allow an objective comparison of the effectiveness of experimental video media in mechanics instruction.

The variables in this study included learning media and curiosity as independent variables, and students' conceptual understanding of mechanics as the dependent variable. Learning media were categorized into experimental video media and conventional instruction, whereas curiosity was classified into high and low levels based on students' questionnaire scores. Conceptual understanding of mechanics was measured as a learning outcome reflecting students' ability to comprehend, explain, and apply fundamental mechanics concepts.

Data were collected using two research instruments: a mechanics conceptual understanding test and a curiosity questionnaire. The conceptual understanding test was designed to assess students' mastery of mechanics topics, including motion, force, and Newton's laws, with an emphasis on conceptual reasoning rather than rote calculation. The curiosity questionnaire was used to identify students' levels of curiosity during the learning process, encompassing indicators such as interest in the subject matter, willingness to ask questions, and motivation to explore physical phenomena.

The research procedure began with the administration of the curiosity questionnaire to categorize students into high- and low-curiosity groups. Subsequently, the learning process was conducted according to the designated treatments, with the experimental group receiving instruction through experimental video media and the control group experiencing conventional teaching methods. At the end of the instructional period, a mechanics conceptual understanding test was administered to collect data on students' learning outcomes.

The collected data were analyzed using inferential statistical techniques. Prior to hypothesis testing, prerequisite analyses were conducted through normality and homogeneity tests to ensure that the data met the assumptions required for parametric analysis. Hypothesis testing was then carried out using a two-way analysis of variance (ANOVA), which aimed to determine the effects of experimental video media on students' conceptual understanding of mechanics, the effects of curiosity on conceptual understanding, and the interaction between experimental video media and curiosity in influencing students' conceptual understanding of mechanics.

Result and Discussion

The findings of this study demonstrate that the use of experimental video media significantly enhances students' conceptual understanding of mechanics. This result supports the theoretical assumption that physics concepts, particularly in mechanics, are better understood when abstract principles are presented through concrete and visual representations. Experimental videos allow students to observe physical phenomena such as motion, force, and Newton's laws in a structured and repeatable manner, which facilitates conceptual construction rather than rote memorization. This finding is consistent with Hafizah (2020), who reported that video-based instruction in physics improves students' ability to grasp abstract concepts by bridging theory and observable phenomena.

The effectiveness of experimental video media can also be explained by its capacity to simulate laboratory experiences when direct experimentation is constrained by limited equipment, time, or safety concerns. Al-Hammoud (2019) emphasized that videos illustrating experiments experienced alongside hands-on or observational activities significantly strengthen mechanics knowledge, as learners are able to connect symbolic representations with real-world behavior of physical systems. Similarly, Jawil and Hajeriati (2025) found that video-based laboratory materials in mechanics significantly improved students' conceptual test scores, reinforcing the role of visual experimentation as an alternative or complement to traditional laboratory work.

Beyond instructional media, the results indicate that curiosity plays a crucial role in shaping students' conceptual understanding of mechanics. Students with higher levels of curiosity consistently demonstrated better conceptual comprehension than those with lower curiosity. This finding aligns with Harianja (2020), who argued that curiosity functions as an internal drive that encourages learners to explore, question, and seek causal explanations in physics learning. From a cognitive perspective, curiosity enhances attention and persistence, enabling students to engage more deeply with conceptual problems rather than relying on surface-level strategies.

Moreover, this study reveals a significant interaction between experimental video media and curiosity. The highest level of conceptual understanding was achieved by students who were exposed to experimental video media and possessed high curiosity. This interaction suggests that instructional media alone is insufficient if not accompanied by students' intrinsic motivation to

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learn. Experimental videos appear to be particularly effective when they stimulate curiosity by presenting phenomena that provoke questioning and inquiry. This finding is in line with Sari and Nana (2020), who demonstrated that virtual laboratory approaches supported by inquiry-oriented models reduce misconceptions and strengthen conceptual relationships among physical variables.

The interaction effect also supports the view that affective factors and instructional strategies are mutually reinforcing rather than independent. Jati et al. (2024) emphasized that learning models which actively promote curiosity tend to improve conceptual understanding because students are cognitively and emotionally invested in the learning process. In this context, experimental videos serve not only as content delivery tools but also as catalysts for inquiry, encouraging students to hypothesize, observe, and interpret physical phenomena.

From a broader perspective, the findings of this study resonate with global trends in physics education research that emphasize technology integration and student-centered learning. Bibliometric analyses using tools such as VOSviewer and Publish or Perish have shown increasing scholarly attention to video-based experimentation and conceptual understanding in mechanics (Nandiyanto et al., 2021; Van Eck & Waltman, 2023). This trend reflects a growing recognition that meaningful physics learning requires both effective visualization and active cognitive engagement.

Overall, the discussion highlights that improving students' conceptual understanding of mechanics necessitates a synergistic approach that integrates instructional media and affective dimensions of learning. Experimental video media provide the necessary visual and contextual scaffolding, while curiosity sustains students' engagement and conceptual exploration. When these elements are combined, students are more likely to achieve deep and durable understanding of fundamental mechanics concepts, which are essential for mastering more advanced topics in physics.

Conclusion

Based on the results and discussion of this study, it can be concluded that the use of experimental video media has a significant positive effect on students' conceptual understanding of mechanics. Students who learned through experimental video media demonstrated better comprehension of mechanics concepts compared to those who experienced conventional instruction. This finding confirms that visualizing physical phenomena through experimental videos helps students connect abstract theories with observable events, thereby enhancing meaningful learning and reducing misconceptions.

Furthermore, students' curiosity was found to have a significant influence on their conceptual understanding of mechanics. Students with higher levels of curiosity achieved better learning outcomes, indicating that curiosity functions as an important internal factor that encourages active engagement, critical thinking, and deeper conceptual processing. This study also revealed a significant interaction between experimental video media and curiosity, showing that the highest conceptual understanding was attained by students who learned through experimental video media and possessed high curiosity. This interaction highlights the importance of integrating effective learning media with affective factors to optimize learning outcomes.

Overall, the findings suggest that improving students' conceptual understanding of mechanics requires not only appropriate instructional strategies but also attention to students' intrinsic motivation. The integration of experimental video media and the cultivation of curiosity can create a more effective and engaging physics learning environment.

Based on the conclusions of this study, several suggestions can be proposed. Teachers are encouraged to integrate experimental video media into physics instruction, particularly in mechanics topics that involve abstract concepts and complex phenomena. Such media should be designed and implemented in ways that actively stimulate students' curiosity, for example through inquiry-based questions or problem-solving activities embedded within the videos.

Future researchers are advised to extend this study by involving larger and more diverse samples to enhance the generalizability of the findings. Further research may also explore other affective variables, such as motivation or self-efficacy, in combination with different types of technology-based learning media. Additionally, longitudinal studies could be conducted to examine the long-term impact of experimental video media and curiosity on students' conceptual understanding in physics.

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Author Contributions

The author solely conducted this research. The author was responsible for the conceptualization of the study, formulation of the research design, development of research instruments, data collection, data analysis, and interpretation of the results. In addition, the author prepared the original manuscript, conducted revisions, and approved the final version of the article for publication.

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