UAD Pendidikan Program Doktor
E-ISSN: 3048-4316
P-ISSN: 3048-4324
CECE
Contemporary Education and Community Engagement
https://journal1.uad.ac.id/index.php/CECE/

Development of Problem-Based Learning Video Using Renderforest Application on Pythagoras Material

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ABSTRACT

This study explores the significant role of animated videos in enhancing students' learning motivation, grounded in the principles of motivational elements. Animated videos capture and sustain attention through visual appeal, engaging storytelling, interactivity, and emotionally engaging content. These elements make learning more relatable and enjoyable, leading to increased motivation and retention. Cognitive Load Theory posits that learners have a limited capacity for processing information, and animated videos can effectively manage the cognitive load by segmenting information, utilizing dual coding, and providing visual cues to guide attention. The successful development of a video-based learning medium on the Pythagorean theorem for eighth-grade students, created using the Renderforest application, demonstrates the practical application and potential of animated videos in education. The study suggests further development of such media into comprehensive, interactive applications to enhance students' learning motivation and understanding, highlighting the transformative potential of animation in educational settings.

Keywords: learning video, problem-based learning, Pythagoras, Renderforest

INTRODUCTION

Mathematics is a subject taught at all educational levels, from elementary to university. It plays a crucial role in education due to its abstract nature and the need for a good conceptual understanding [1]-[3]. Understanding new concepts requires a prerequisite understanding of previous concepts, allowing knowledge to be built based on individual learning experiences, developmental stages, and the surrounding environment. According to the Indonesian National Education Standards, the goal of mathematics education is for students to understand mathematical concepts, explain the interrelationships between concepts, and apply them accurately, efficiently, and effectively to solve problems, which includes understanding

Article Received 23 February 2024. Revised 30 May 2024.

problems, designing mathematical models, solving these models, and interpreting the obtained solutions [4].

Educators should manage the learning process to motivate students, foster creativity, and continuously innovate in providing learning materials and media [5]. This is especially necessary in mathematics education, where students often become quickly bored. Cognitive development transitions from concrete operational thinking to formal operational thinking, meaning students may struggle with abstract thinking [6][7]. Therefore, learning media is needed to support cognitive development. In mathematics education, media serves as a communication tool between educators and students to clarify abstract concepts.

Online learning involves using web networks, requiring educators to prepare materials using technology. Online learning poses challenges, such as difficulties in understanding the material, engaging students actively, and using technology effectively in mathematics education [8]-[10]. Developing learning media remains a common topic among educators and researchers. Some focus on developing learning modules, while others explore interactive media using current technological advancements. Interactive media can significantly aid learning activities. Additionally, some researchers develop learning media in the form of videos. Using Information and Communication Technology (ICT) based media can improve the quality of learning. To enhance learning effectiveness and efficiency, innovative and creative learning models should be developed to avoid monotonous and boring lessons that hinder knowledge transfer. Teaching materials play a vital role in delivering content effectively to students.

According to Ref. [11], e-learning is a technological development that can be used as a learning medium. It not only delivers content but also enhances various student competencies. The use of learning media is crucial in the applied learning method. One example of media implemented using educational technology is video-based learning. Ref. [12] states that animated learning videos significantly impact learning motivation. The educational videos boost students' enthusiasm for learning activities, indicating that modern advancements positively affect students by providing video-based learning models that support learning activities [13][14]. The new educational paradigm aims not only to change students' character but also to build integrity and a global mindset. Designing and creating learning videos involves several stages, including organizing the material structure from the syllabus, structuring the learning video, collecting relevant data, and developing the video's appearance.

The Indonesian Ministry of Education and Culture decree on process standards states that learning models appropriate for the 2013 Curriculum include inquiry-based learning, discovery learning, project-based learning, and problem-based learning [15]. However, many teachers still do not fully implement the 2013 Curriculum. Effective learning requires supportive materials, such as teaching materials. Problem-Based Learning (PBL) connects mathematical problems with real-life contexts, helping students develop thinking and problem-solving skills through real-world experiences [16]-[18].

PBL is chosen for mathematics education due to its relevance to discovery learning and mathematical skills [16]. In mathematics, cognitive, affective, and psychomotor aspects are interconnected. The affective aspect relates to students' attitudes and emotions toward mathematics, while the cognitive aspect involves discovering important information or solutions to problems. The psychomotor aspect requires students to have good mathematical skills to solve problems. Teachers can guide students in investigating these problems. Developing these three aspects in students makes it easier for them to apply mathematical facts, concepts, and operations. Based on the described needs in mathematics education, this study aims to develop a video-based learning medium for teaching Pythagoras in schools.

METHODS

This study employs the Research and Development (RD) approach to produce a video-based learning medium on Pythagoras for eighth-grade students. The learning objectives include solving problems related to Pythagoras. The Problem-Based Learning (PBL) model involves students in projects to produce a product. Given the abstract nature of mathematics, appropriate learning methods are needed to help students understand the subject effectively. According to Ruseffendi (2006), "Mathematics is considered a difficult, complex, and challenging subject." The teaching method used is discussion, where students interact, exchange opinions and defend their views on problem-solving to reach a consensus.

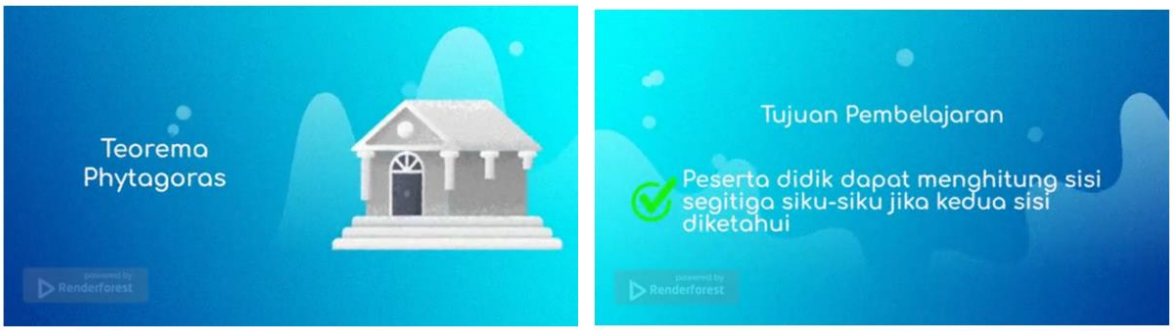
The research process includes planning, production, and evaluation. In the planning stage, the product is designed based on needs analysis through interviews with educators and literature studies. The production stage involves developing a PBL-based video on Pythagoras using the Renderforest application. In the evaluation stage, the product is assessed by expert judgment until it reaches validity. Product feasibility is measured using Beta Testing or product usage testing. Data collection techniques include questionnaires with Likert scales completed by respondents.

RESULTS AND DISCUSSION

The chosen medium for this study is a learning video-assisted by the Renderforest application, an innovative tool that facilitates the creation of high-quality animated content. This video-based learning format aligns perfectly with the selected media, as it allows for the integration of various educational elements designed to engage students and enhance their learning experience. The presentation format is meticulously adjusted to cater to the educational needs of the students, ensuring that the content is both accessible and engaging.

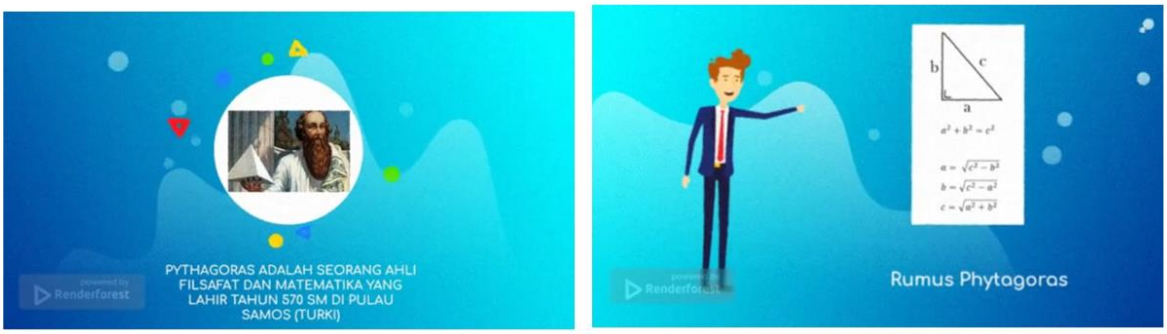
The video-based learning medium developed using Renderforest is thoughtfully structured to optimize learning outcomes. It employs a combination of visual and auditory stimuli to present information clearly and engagingly. Key concepts are broken down into manageable segments, and each segment is carefully designed to maintain students' attention and facilitate understanding. The use of vibrant colors, dynamic animations, and interactive elements helps to make complex topics more comprehensible and memorable.

The structured approach of the video-based learning medium using Renderforest is illustrated in Fig. 1 to Fig. 3. This figure outlines the organization of the content, the sequencing of topics, and the integration of interactive elements. It serves as a visual representation of how the educational material is designed to flow, ensuring a logical progression of ideas that supports effective learning. This structured format not only aligns with the educational objectives but also leverages the capabilities of the Renderforest application to create a compelling learning experience.



(a) (b)

Fig. 1. The learning video using Renderforest. (a) the media cover, (b) the learning objectives



(a) (b)

Fig. 2. The learning video using Renderforest. (a) the description of the Pythagoras definition, and (b) the formulae of the Pythagoras

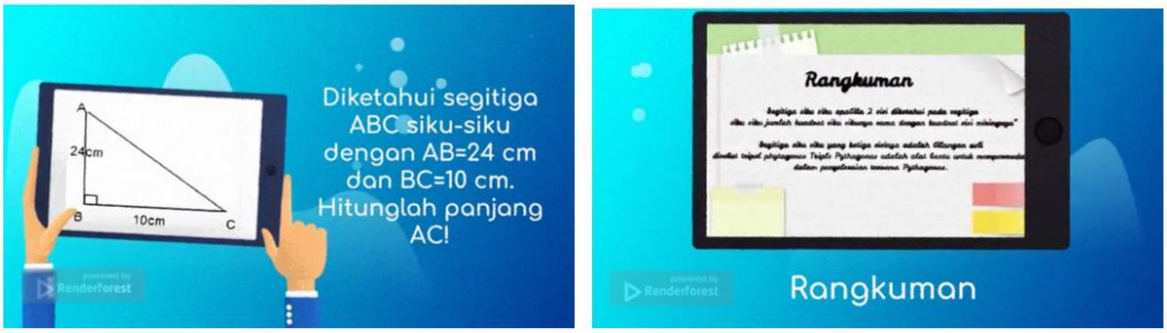


Fig. 3. The learning video using Renderforest. (a) the problem example, (b) the summary

The use of animated videos in education plays a crucial role in enhancing students' learning motivation [12]. Motivational elements in animated videos, such as visual appeal, storytelling, interactivity, and emotionally engaging content, can capture and sustain students' attention more effectively than static images or text [19]. The vibrant colors, dynamic movements, and engaging graphics in animated videos make them more attractive [20]. The narrative approach often used in animated videos helps make learning content more relatable and memorable [21], while interactive elements such as quizzes and pauses for reflection encourage students to engage actively with the content [22].

Cognitive Load Theory (CLT) posits that learners have a limited capacity for processing information. To maximize learning efficiency, instructional materials should be designed to minimize unnecessary cognitive load [23]. Animated videos manage cognitive load through several strategies, such as segmenting information into smaller, manageable parts and using the modality principle, which leverages both visual and auditory channels to present information. Additionally, the signaling principle, which uses visual cues like arrows or highlights, helps guide students' attention to the most important parts of the lesson, and dual coding, which

combines verbal and non-verbal information, reinforces learning through multiple channels and improves recall.

The study that successfully developed a video-based learning medium on Pythagoras for eighth-grade students using the Renderforest application is a concrete example of the potential of animated videos in education. This video not only simplifies the geometric principles of the Pythagorean theorem but also enhances student engagement through the motivational elements mentioned. To further enhance students' learning motivation and understanding, it is suggested to develop such video-based learning media into more comprehensive applications. These applications can offer interactive features, personalized learning paths, and immediate feedback, all of which contribute to sustained motivation and deeper comprehension. By continually integrating advancements in animation and educational technology, educators can create dynamic learning environments that cater to diverse learning needs.

Overall, animated videos play a crucial role in enhancing learning motivation by incorporating visual appeal, engaging storytelling, interactivity, and emotional engagement. When designed in alignment with Cognitive Load Theory, these videos effectively manage cognitive load, making complex concepts more accessible. The development of video-based learning media, such as the Pythagoras video for eighth-grade students, demonstrates the transformative potential of animation in education. Moving forward, the expansion of such media into interactive applications holds promise for further improving student motivation and understanding.

CONCLUSION

In conclusion, animated videos play a pivotal role in enhancing students' learning motivation by leveraging visual appeal, storytelling, interactivity, and emotional engagement. These videos effectively manage cognitive load, making complex concepts more accessible and memorable. The successful development of a video-based learning medium on Pythagoras for eighth-grade students exemplifies the potential of animation in education. To further boost students' motivation and understanding, developing such media into comprehensive, interactive applications is highly recommended. This approach promises to create dynamic and engaging learning environments that cater to diverse educational needs, ultimately transforming the educational experience.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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