Transforming Physics Learning: Developing AI-Based Interactive Videos to Understand Newton's Laws

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A R T I C L E   I N F O

A B S T R A C T

This study aims to describe the results of the needs analysis conducted at SMA Negeri 3 Prabumulih as a basis for developing artificial intelligence-based learning videos for differentiated physics learning. Data analysis was carried out using validation sheet data, questionnaires and interviews. This study serves as a preliminary study at the definition stage, where researchers ensure that the products developed meet the needs of teachers and students. The results of the questionnaire as many as 92.3% (150 respondents), stated that they agreed that SMA uses learning videos for every physics material. This is because physics material is learning material that is difficult for students to understand. The results of the description of the assessment data by the media validator on the media in the form of learning videos are in the very good qualification, this is categorized as very good. The trial results show that products that are equipped with practical aspects shown to teachers and students are categorized as very practical. So the level of validity of this learning video media is said to be very valid because it is in the range of 92.82% and the level of practicality of the media in the form of learning videos is 97.28% categorized as very good.

Introduction

In this era of globalization, technological advances have significantly changed modern life, creating various challenges in various fields, including education. Public access to information is increasingly easy, and communication between individuals can occur without time and place limits. At this time, society is very dependent on information technology in all aspects of life (Umi Kalsum et al, 2023).

Similarly, we all know that the advancement of ICT has long been utilized by many countries (Gunawan et al, 2021), both developed and developing countries in overcoming various problems/obstacles to improve the quality of education in general (Anwas, 2010) and teacher competence in particular (Sugiarti, 2012). According to Siahaan (2013), that with the advancement of Information and Communication Technology (ICT), a person now has the opportunity to take part in educational or learning programs organized by educational institutions abroad without having to be in that country. This means that anyone can now learn and develop their potential without having to move or live in the country that organizes the educational program (Siahaan, 2013).

Current technology is expected to make physics learning more interesting and structured, so that teachers are expected to create learning media that can improve student learning outcomes (Fitriani & Yudiana, 2022). To find solutions to various daily problems faced today, a technological innovation called Artificial Intelligence or artificial intelligence has been developed (Maufidhoh & Maghfirah, 2023). To improve quality learning according to 21st century thinking skills, UNESCO also has a mission in the era of the industrial revolution 4.0 by promoting artificial intelligence/artificial intelligence (Gunawan et al, 2021). Artificial Intelligence technology can be

applied to education if teachers have the ability to operate the AI (Mawarwati & Yanti, 2023). One proof that education is developing by utilizing technological developments is not only in verbal form but also in text, visual, audio and motion (Luthfi et al, 2023). The presence of AI in supporting the diversity needed to support the needs of teachers in learning activities (Gunawan et al, 2021). The positive impact of Artificial Intelligence in physics learning is that students become more enthusiastic in participating in learning because varied learning assisted by AI as a learning medium can improve the learning experience and help teachers in providing more personal and effective education (Maufidhoh & Maghfirah, 2023). Based on the results of the observational research that has been carried out, data was obtained that there is a need for learning videos for each physics material, especially in Newton's law material. Where, in this Newton's law material, it is a basic concept that is important for high school students to understand as a first step to studying physics material in more depth. Then also, the use of artificial intelligence-based learning videos can facilitate students' technological literacy in high school.

The development of Artificial Intelligence (AI)-based educational videos has become one of the promising innovations in modern education. With the advancement of technology, particularly in the field of AI, educational content can now be presented in a more interactive, personalized, and adaptive manner according to individual needs. According to Chen (2020), AI in education allows content to be delivered in a more effective and engaging way, using features such as data analysis, content recommendations, and adaptations based on students' learning styles. Liu and Zeng (2021) also highlight how AI-based educational videos can function as personal tutors, providing customized learning experiences. Additionally, Biswas and Leelawong (2019) suggest that AI in educational videos can utilize algorithms to provide real-time, in-depth feedback to students, accelerating their understanding. This is further supported by research from Hwang and Chen (2020), which states that AI technology can enhance student engagement through problem-based interaction and simulations within educational videos.

Baturay and Kucuk (2020) also emphasize the importance of utilizing AI in learning analytics to improve teaching effectiveness, especially in video-based learning environments. D'Mello and Graesser (2018) assert that AI technology can assess students' emotional states and adjust content based on their feelings and engagement. Zhang and Li (2021) add

that AI can create a more personalized learning experience by leveraging big data to identify relevant patterns in students' learning styles. Moreover, Nouri and Zhang (2021) reveal that the integration of AI in educational videos can enhance the quality of interactions between students and the content, as well as speed up the learning process. This concept is supported by Almalki et al. (2020), who identify challenges and opportunities in applying AI to create more dynamic and adaptive video content. Finally, Hao and Zhao (2019) emphasize that AI-based educational videos can support remote learning and e-learning by delivering relevant and up-to-date materials. Therefore, the development of AI-based educational videos has the potential to transform the traditional education paradigm and accelerate the adoption of more advanced digital learning.

Methods

Research Procedures

In this study, the researcher used the type of development research or Research and Development (RnD). Development research is used in order to produce a product and to test the effectiveness of the product that has been produced by Sugiyono (2015:297). The stages carried out in the development of interactive learning videos based on artificial intelligence use the Alessi & Trollip development model. In this development model, there are 3 stages, namely the planning stage, the design stage, and the development stage. The procedures for this research are as follows:

Figure 1
Alessi and Trollip Research Flow
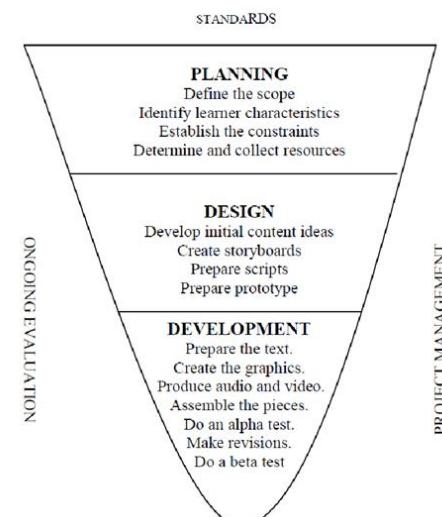
1) The Planning Stage includes the scope of material as the achievement of learning activities used in class XI SMA. Analysis of students shows that at SMAN 3 Prabumulih the use of technology in learning is very good where all students are required to use gadgets/cellphones during the learning process.

2) The Design Stage focuses on the detailed design details of the entire media project, with a special emphasis on media documents. A good design document is important and introduces several procedures for designing, content and producing design documents that are effectively communicated to all the details of the needs to complete the media project.

3) The media Development Stage is carried out by making animated video media, the design stage includes video scripts, images, character designs, then supporting background sound and sound recording. The media that has been developed needs validation from material experts and media experts to determine the validity of the animated video media. The input and suggestion validation stage is useful for improving animated media products to measure the validity of the developed product before being tested in the field. The validation stage is carried out by material experts, media experts and teachers through assessment instruments. And at this development stage, an assessment of the practicality of product use by students is also carried out through the practicality instrument of the product development.

Data Collection Technique

The data collection techniques used in this study are as follows:

Media Product Validation

The instrument validation process is carried out by several experts or experienced experts to assess and evaluate the development results. The data collection tool used is a validation sheet given to experts and interviews. The validation sheet is used for learning videos on Newton's law material that has been developed to obtain assessments and responses in the form of comments and suggestions for improvement from experts on the media that has been designed, both in terms of content and media aspect

Questionnaire

Questionnaire is a data collection technique carried out by giving a set of written questions or statements to respondents to be answered (Sugiyono, 2013). The researcher gave a questionnaire to students on the video that had been designed in learning Newton's law to see the practicality of the media.

Data Analysis Techniques

After the data is obtained, the next step is to analyze the data. The techniques used in this study to analyze the data are as follows:

Validation Sheet Data Analysis

The results of expert/validator validation are analyzed descriptively qualitatively, the validation results from the validator on all aspects assessed on the validation instrument sheet are presented in the form of a product validity table. The collected data is processed by adding them up, comparing them with the expected amount and obtaining a percentage (Arikunto, 1985). The feasibility of developing learning media, use the following Table 1.

Table 1
Validation Value Category

Percentage of achievement	Interpretation
76-100	Good
56-75	Pretty Good
40-55	Not Good
0-39	Not Feasible

Questionnaire Data Analysis

The data obtained through the questionnaire were analyzed using a Likert scale to measure students' opinions on the usability of artificial intelligence learning videos. The questionnaire data were obtained by calculating the scores of students who answered all the questions in the questionnaire. The data were analyzed using the percentage technique:

$$\text{Percentage} = \frac{Total\ score\ of\ students'\ answers}{Total\ Score} \times 100$$

To find out whether this learning video is practical to use on Newton's law matter, the analysis data is interpreted using the criteria as in the Table 2.

Table 2
Criteria for Interpretation of Questionnaire Scores in Learning Videos

Questionnaire Score (%)	Alternative Answer Choices
81-100	Very Practical
61-80	Practical
41-60	Quite Practical
21-40	Not Practical
0-20	Very Not Practical

Result and Discussions

Based on the documentation results of grade XI students of SMAN 3 Prabumulih, in one of the 32 statements in the questionnaire, the majority of students chose to agree with the use of learning videos in every physics subject. A total of 150 respondents filled out the needs analysis questionnaire. The results of the questionnaire were 92.3% or 98 respondents agreed if the high school used learning videos in every physics material. This is because physics material is learning material that is difficult for students to understand. Therefore, 90% of students need to use physics learning videos to support their understanding of physics concepts. Then as many as 87.7% or 95 students chose to agree, if the teacher explains the material using video learning media, students will find it easier to understand physics concepts than using other learning media. Video learning media is the most effective media used by students during the learning process as a medium to increase information on students' understanding of physics concepts.

Table 3
Analysis of The Use Of Physics Learning Videos

Part	(%)
Students desire to use physics learning videos in class.	92,3
Development of artificial intelligence-based physics learning videos.	89,2
Implementation of the use of artificial intelligence-based physics learning videos in schools	93,8
AI-based physics learning videos help understand technological literacy in the school	96,9
Student responses regarding researchers conducting research regarding the development of AI-based learning videos.	89,2

Expert Validation Results Analysis

Validation conducted by media, design & language, and material experts. The results of the expert validator's assessment are presented in Table 4.

Table 4
Expert Validation Results

Validator	Percentage (%)
MA	98,82
EAP	84,44
SR	93,33
Average Score Percentage	92,2
Qualification	Very Valid

Based on the results of the validation and trials that have been carried out, as well as the achievement of valid and practical learning video media products based on various theories, this is a tool that can support the learning evaluation process and provide a positive impact on students.

Based on the results of the research that has been conducted, the media developed has proven to be valid and practical, this can be seen from the questionnaire responses of students and teachers of Physics Subjects which showed very good results. Thus, the media can be used sustainably at SMA Negeri 3 Unggulan Prabumulih. During the process of developing this interactive learning media, researchers faced various obstacles, but all of these problems can be overcome well, so that they succeeded in producing interactive learning media products for Physics Subjects that are in accordance with the needs at SMA Negeri 3 Unggulan Prabumulih.

Table 5
Results of The Individual Trial Assessment Questionnaire.

No	Indicator	Average Score (%)	Information
1	Learning videos can be used to explain the material	98,4	Very Good
2	Learning videoes can increase student's enthusiasm for learning	94,4	Very Good
3	Learning Videos can be used to learn objects that are difficult to represent directly	96,8	Very Good
4	Easy learning videos to use	97,6	Very Good
5	Easy to access learning videos on any device	97,6	Very Good
6	The material in learning videos is easy to understand	96,8	Very Good
7	Easy learning videos to carry	96,8	Very Good
8	Text on learning videos easy to read	97,6	Very Good
9	Satisfication felt after using learning videos	98,4	Very Good
10	Fun learning videos are used in learning activities	98,4	Very Good
Overall Aspect Average (%)		97,28	Very Good

So, from the research results obtained, the developed learning video can be said to be a valid and practical artificial intelligence-based learning video.

Figure 2
Newton's First Law Video

Figure 3
Newton's Second Law Video
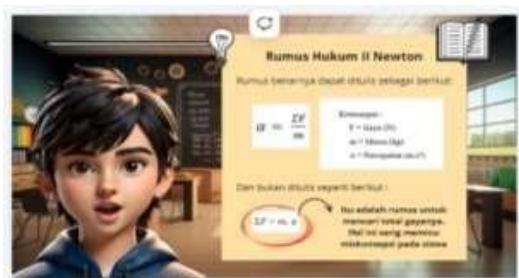
Figure 4
Newton's Third Law Video

In addition, learning videos are packaged in an interactive learning media using the AI system in the Canva application which can be accessed by students.

Figure 5
Interactive Learning Media
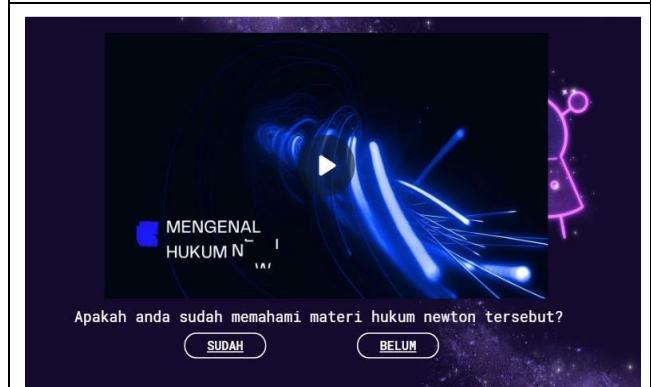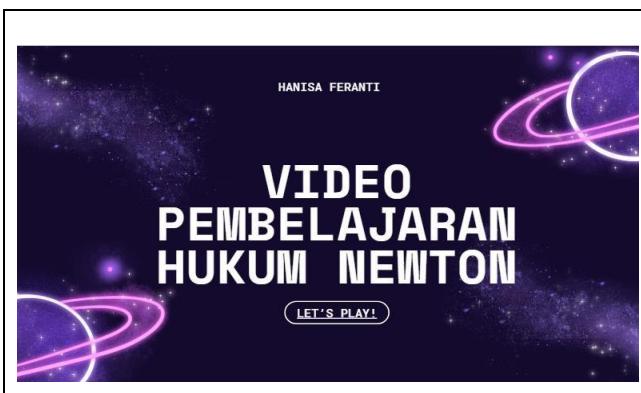
AI-based video creation using D-ID begins with defining the concept and purpose of the video. The first step is to collect materials such as text, images, or scripts that will be used in the video. These materials are then uploaded to the D-ID platform, which allows the creation of videos using deep learning technology. D-ID uses AI to generate

animated faces that are in sync with the given text, as well as providing users with the option to choose from a variety of facial expressions and appearances that match the mood or message of the video. Once the visual and audio components are prepared, the next step is to refine the video by adjusting the duration, transitions, and other animations to ensure that the video is engaging and easy to understand. The video can then be tested to ensure that it is appropriate for the intended learning objectives, with further adjustments if necessary. Finally, the finished video can be downloaded or uploaded for use in an educational context or other purposes.

The AI-based learning video developed in this study is an update to learning videos in general. This learning video incorporates elements of AI animation into the learning video so that the learning video is an update in research that has never been developed before. By using AI animation, of course, the learning video that is made is more interesting and the animation looks more real. Meanwhile, the advantages of research related to AI-based learning videos compared to previous research are that in previous research only the development of learning videos was carried out as usual, but in this study the learning videos were made using 3D AI animation elements so that the AI animation in the learning videos looked real.

The researcher's experience in developing learning videos in the form of AI animations on platforms such as D-ID and Canva began with an exploration of both tools and an understanding of how they can be used to improve the quality of learning. The use of D-ID in making AI-based animated videos allows researchers to create very realistic animated characters, which can convey material in narrative form. One of the challenges faced is ensuring that the resulting animated characters can speak naturally and in accordance with the learning context. Although D-ID offers the ability to convert text to voice, researchers found that choosing the right voice and matching facial expressions to the material presented required some adjustments so that the results were more optimal and easy for students to understand.

On the other hand, the experience of using Canva also makes it easier to create learning videos that are more based on visual design. This platform provides various animation templates and graphic elements that allow researchers to create visually appealing learning videos without requiring in-depth graphic design skills. The researchers found that Canva was very effective for creating videos with lighter concepts, such as explanations of mathematical or language concepts, where creative visualizations could clarify the material. However, the researchers faced limitations when it came to more complex animations, where Canva did not provide full control for more interactive or dynamic animations, as D-ID could. During video development, the researchers also explored how the two platforms could be used to meet the different needs of students. D-ID allowed the researchers to create animated characters that could interact directly with the text, while Canva gave them the freedom to create more dynamic and varied visual displays. The researchers felt that D-ID was more effective for materials that required direct narration or explanation, while Canva was better suited for learning videos that focused on data visualization or concepts that needed to be demonstrated through graphs and diagrams. The application of these two platforms in the context of learning led to the development of more varied materials, tailored to the topic being taught.

One of the things that researchers learned in developing this AI animated learning video is the importance of adjusting to student preferences. With D-ID, researchers were able to adjust the narrative and expression of the animated characters to suit the learning styles of students who require direct visualization of abstract concepts. On the other hand, the use of Canva provides flexibility in creating content that can be easily adapted to the needs of the audience, whether in the form of short, concise videos or longer, more in-depth learning videos. This experience taught researchers that adaptation to the type of material and audience is essential to creating effective and engaging learning videos.

The researchers' experience in using D-ID and Canva also shows the importance of collaboration between technology and pedagogical understanding. Although both platforms provide powerful tools for creating learning content, researchers realize that the use of these tools must still be based on good teaching principles. Learning must remain focused on educational goals. Researchers feel that by understanding how each platform works and how they can be adapted to learning goals, the development of this AI animated learning video can have a greater impact on the learning process.

In this study, validation and product trials have been carried out involving the assistance of various parties to measure the results of the feasibility and practicality of this AI-based learning video product. The results show that the AI-based learning video product is very valid and very practical, this is based on the assessment of the expert validator team, students, and subject teachers. This success cannot be separated from the advantages of AI-based learning

videos as multimedia, this is explained by Latuheru (1993), who emphasized the importance of developing learning media in a multimedia system that combines various media for learning purposes. Feasibility and practicality of video products.

Conclusions

The development of learning videos begins with identifying student needs. Based on the findings of this needs assessment, the physics learning process, especially Newton's laws, is considered good, while the need for learning media is considered very good. These results are very important for researchers in designing and developing learning videos that are much needed at SMA Negeri 3 Unggulan Prabumulih. The results of the description of the assessment data by the media validator on the media in the form of learning videos are in the very good qualification, this is categorized as very good, and the results of the description of the assessment data by the material expert validator on the learning media are in the very good qualification, this is categorized as very good. The trial results show that products equipped with practical aspects that are shown to teachers and students are categorized as very practical. So the level of validity of this learning video media is said to be very valid because it is in the range above 90% and the level of practicality of the media in the form of learning videos is categorized as very good.

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