

INTERACTIVE LEARNING MEDIA FOR CRITICAL AND CREATIVE THINKING SKILLS DEVELOPMENT

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ABSTRACT

Learning demands new innovations in the form of interactive learning media to enhance students' critical and creative thinking skills. Currently, most high school physics teachers do not create their own instructional media. This renders it difficult for teachers to modify it to pupils' requirements. The goal of this research is to provide learning media with critical and creative thinking skills based on the concept of simple harmonic motion. The ADDIE model was applied in this form of research and development (R&D). Three physics academics from Universitas Negeri Padang evaluated the product's validity. With a valid category, product validity obtained an average value of 0.83. A valid product indicates that learning media can be used for learning. After the product's validity has been established, practicality and efficacy testing can be performed. This study, on the other hand, exclusively showed validity data.

Keywords : Critical Thinking Skills, Creative Thinking Skills, Simple Harmonic Motion, Interactive Learning Media.



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I. INTRODUCTION

The parameters of a nation's progress can be measured by how revolution 4.0 education advances science and technology [1,2]. Technology can be useful in the field of education [3]. This is consistent with the Fourth Industrial Revolution, in which advances in science and technology present a new challenge in the field of education. The use of technology can help to improve educational quality. Extraordinary breakthroughs in education quality improvement The government can address this issue by aligning the curriculum with the times. The current curriculum is the 2013 curriculum. Curriculum development is done to improve educational quality by creating a new curriculum that requires students to be more active in the learning process [4].

The 2013 curriculum emphasizes 21st century skills [5]. The 2013 curriculum aims to teach students 4C skills (communication, collaboration, critical thinking, and creativity) [6], scientific literacy, character education, and Higher Order Thinking Skills (HOTS) [7]. Science cannot be transferred from teacher to student, according to the 2013 curriculum. Students are subjects who actively investigate, process, construct, and apply knowledge. During the learning process, students must be given the opportunity to construct knowledge [8].

Effective learning occurs when students and teachers interact reciprocally while using various types of teaching concepts and learning resources such as learning media. Teaching concepts are the most important component in achieving learning objectives, as learning concepts must be relevant to learning objectives, student characteristics, and the use of learning concepts provided by teachers to students in order for students to achieve certain competencies and abilities [9]. Student-centered learning is a learning strategy that teachers can employ. Student-centered learning can help students become more creative, innovative, and critical thinkers. Students can apply what they've learned to real-world problems [10].

Physics learning assists students in analyzing the concepts and solving a given problem during the learning process [11]. The ability to think is divided into two categories: basic thinking skills and higher-order thinking skills. Basic thinking skills are skills that are general in nature, while higher-order thinking skills require students to solve problems and make decisions [12]. The primary characteristics of higher order thinking are critical and creative thinking abilities [13].

Critical thinking abilities are not a new concept in the academic world. Students' critical thinking skills are one indicator that can be used as a benchmark for learning success. Critical thinking skills in learning are cognitive processes that allow students to recognize, analyze, and evaluate information. The presence of critical thinking skills can raise a variety of questions and important issues, which are then formulated and assessed information pertinently while keeping an open mind [14]. Critical thinking abilities are essential for students. Students with critical thinking skills can apply scientific concepts, solve problems, and are not easily swayed by societal issues that lack clear evidence.

Creative thinking skills are the ability to discover new things that did not previously exist, to be original, to develop new solutions for each problem, and to generate new, varied, and unique ideas [15]. Creativity in the creation of a new product or the combination of existing things is an example of the outcome of creative thinking skills [16]. Creativity and problem-solving ideas rely heavily on creative thinking skills [17]. Everyone has different creative thinking characteristics. Stimulation is expected to be able to develop students' creative thinking skills. The ability to think creatively is critical for students to develop and own during and after the learning process [18]. Stimulation is expected to help students develop their creative thinking abilities. To be able to develop creative thinking skills in learning, students must be actively involved so that their creative thinking skills can be well developed [19].

There are several types of teaching concepts, including print and electronic media for interactive learning media (interactive teaching concept) [20]. Interactive learning media is a medium for communicating messages between educators and students that allows communication between humans and technology through systems and infrastructure in the form of application programs and the use of electronic media as part of the educational method. Learning can be done anywhere and at any time using interactive learning media. Concepts, audio and visual communication displays, learning designs, and software utilization are all aspects of good physics interactive learning media. The use of media in the delivery of learning will almost certainly encourage more innovation in learning methods that can increase student motivation and learning outcomes [21].

Students' critical thinking and creative thinking skills in Indonesia remain relatively low. One example can be found in the results of the average Senior High School National Exam scores in 2019. Table 1 shows the average results of Senior High School National Exam scores in Padang City over the last four years for physics lessons.

Table 1. Graph of Physics National Exam Scores for the preceding four years

Year	National Exam Physics Average Score
2016	71,55
2017	62,33
2018	47,33
2019	50,1

Based on the results of the 2019 Physics National Examination, it was determined that the critical thinking skills and creative thinking of students in Padang City are low, and have even decreased year after year. The 2013 curriculum should require students to master higher-order thinking skills. The ability to think critically and creatively is one indicator of higher order thinking skills. According to the findings of an interview with a physics teacher regarding critical and creative thinking skills, students' critical and creative thinking skills remain low. When HOTS-based questions are provided, pupils express greater frustration with the difficulty of answering these questions. One of the issues, notably in terms of students' style of thinking, which remains poor, and also because students still do not understand the concept provided by the teacher during the learning process.

Mechanics concept is classified as difficult concept for students based on observations made regarding physics learning concept. Students struggle to understand critical and creative thinking skills in this concept because the teacher still uses the lecture method to explain the concept. Based on the observations, this concept is generally only explained verbally, making it difficult for students to understand.

Physics National Exam problems are divided into four categories: Mechanics, Waves and Optics, Thermodynamics, Electromagnet, and Modern Physics. The concept of momentum, impulse, and simple harmonic motion is mechanical in nature. Based on the results of the mechanics National Exam, 50.50% of the questions were HOTS. Students must continue to improve these conditions in order to meet the goals of the 2013 curriculum.

In addition, observations were made on tenth grade students from several high schools in the city of Padang in terms of learning style, interest in interactive learning media, and ability to think critically and creatively. Based on the findings of the student analysis, it can be concluded that students have difficulty understanding physics lessons, enjoy learning with audio-visual, have a strong interest in understanding physics concept using interactive learning media, and students can think critically and creatively but not very well. The most important aspects of carrying out the learning process is the activeness of students in the learning process [22], while the teacher is expected to know the characteristics of students in order to adjust teaching styles based on the characteristics of students.

As a result, the existence of interactive learning media can provide a stimulus for students to improve critical and creative thinking skills by presenting more interesting concept that includes pictures, animations, videos, and practice questions, allowing them to save time in understanding concepts and being accessible anywhere and at any time. Teaching with interactive media is one of the most significant components of the learning process because it allows teachers to easily transfer learning materials [23, 24]. There are differences in teaching and learning activities while using interactive media in learning. Several research [25]–[28] indicate that this is due to how interactive media strives to convert abstract learning content into concrete. Because interactive learning media can enhance students' motivation to study and make learning materials easier to understand, it has a substantial impact on students' interest in learning the competencies presented [29]–[31]. The study was carried out to assess how effective the product is at teaching. However, the data reported in this paper is limited to the validation results of the product being developed. As a result, the goal of this research is to create interactive learning media that are valid for improving students' critical thinking and creative thinking skills.

The concept that will be developed in this product is one of simple harmonic motion. This concept contains many concepts centered on the everyday environment. Of course, this can be given conceptual questions to help students develop their critical thinking and creative thinking skills. Based on the background information, it is necessary to conduct research on interactive learning media in order to improve students' critical and creative thinking skills.

II. METHOD

The ADDIE model was used in the research development model, which passed the stages of Analysis, Design, Development, Implementation, and Evaluation to create learning media products for simple harmonic motion material using the Lectora Inspire application to improve students' critical thinking and creative thinking skills. To create a viable product, research was carried out in accordance with the ADDIE steps, which include Analysis, Design, Development, Implementation, and Evaluations. The researchers focused on the development stage in this study.

The first stage of analysis was the creation of teaching concepts in the form of interactive media in learning objectives, in order to define a problem to be followed up on, which includes an analysis of needs, curriculum, and student characteristics. The second stage of design was to create an interactive learning media framework by creating a design that will allow problems identified during the analysis stage to be resolved. A story board was created during this design stage so that product development can be carried out methodically.

The third stage was development, which aimed to inspire the lecturer with a draft that has been prepared. The points obtained at this stage take the form of interactive learning media that must be created in order to achieve learning objectives. The obtained data were analyzed using Aiken's validity index. The validity test data was analyzed using the validity index of Aiken's V [32]. V is the validator agreement index, l_0 is the lowest validity rating score (in this case = 1), c is the highest validity rating score (in this case = 5), r is a value assigned by an validator, and n is the number of validators .

$$V = \frac{\sum s}{n(c-1)} \quad (1)$$

$$s = r - l_0 \quad (2)$$

After obtaining the rater agreement index, the category of the index value is determined. Table 2 displays the outcomes of category decisions based on the Aiken's V Index. The results of the needs analysis are categorized based on Table 2.

V Value	Information
≤ 0.4	Less
$0.4 < V \leq 0.8$	Moderate
$V > 0.8$	Valid

III. RESULTS AND DISCUSSION

The results of the research include the results of the analysis, design and development stages.

1. Analysis Stage

According to the findings of interviews and surveys submitted by physics teachers at public high schools in Padang, the medium used in learning is power points, Microsoft Word, and YouTube learning videos. Naturally, the teacher's learning media are not interactive and cannot help pupils improve their critical thinking and creative thinking skills. Curriculum analysis is undertaken by researchers in order to adjust the curriculum used in schools to the emergence of interactive learning technology. One purpose of curriculum analysis is to modify the learning methods that must be used [33]. In this study, researchers produced interactive learning media using the simple harmonic motion concepts.

Furthermore, questionnaires were distributed to students with the aim of knowing the students' needs for the learning media to be developed. This step is in line with research conducted by Ramadan [34]. A questionnaire was sent to the students in order to examine their characteristics, which included learning styles, interactive learning medium, critical thinking skills, and creative thinking skills. Students prefer audio and visual learning techniques. Students believed that employing interactive learning media will make learning more engaging, according to the results of the questionnaire distribution

2. Design Stage

The researcher selected Lectora Inspire as the application that will be used in the product development process. Lectora inspire was chosen because it is thought to have components that can support the creation of interactive learning media aimed at improving students' critical and creative thinking skills. The researcher then collects references that will be used as content in the interactive learning media that will be created. Furthermore, the collected concepts become product drafts and compile them in Power Point.

3. Development Stage

Interactive learning media is developed throughout the development process. The researcher's draught will be submitted to the lectora inspire application. The cover, competencies, indicators, learning objectives, concepts, assessment and discussion, product instructions, references, and identity are the components of the product to be constructed. Figure 1 depicts the finished products.



Fig. 1. Product Coverage of Interactive Learning Media

The next step is to validate the product after it has been created. Product validity instruments were used to test product validity. The instrument used has already been validated with a valid category. First, there is the concept's substance, which is consist of three indicators: truth, presentability, and readability. Figure 2 depicts the results of the validity assessment of the concept substance indicators for simple harmonic motion.

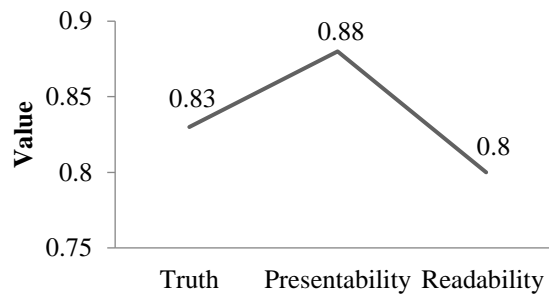


Fig. 2. Concept Substance Validation

Figure 2 shows the concept substance validation results for simple harmonic motion. The truth indicator's validity value is 0.83, presentability is 0.88, and readability is 0.8. The average for the three assessment indicator values for simple harmonic motion concepts substance was 0.83, with a valid category.

According to the data in Figure 2, the results of the assessment indicators about truth can increase students' understanding because the developed media already contains concept that is in accordance with scientific principles presented in accordance with the principles and laws that govern physics. The developed learning media can construct students' knowledge independently by presenting concept that is in accordance with the development of science. The readability assessment indicator indicates that the developed learning media uses effective and easy-to-understand language, preventing multiple interpretations of the concept contained in the developed learning media.

This description shows that there are points of assessment that support the learning media being developed when it comes to assessing the substance of the concept. The assessment items that are evaluated correspond to the required assessment indicators. This is consistent with the results obtained, where the validation results of the three assessment indicators are classified as valid in this assessment.

The display of audio and visual communication. It has four assessment indicators namely, navigation, typography, media and layout. The results of validating the display of audio and visual communication can be seen in Figure 3.

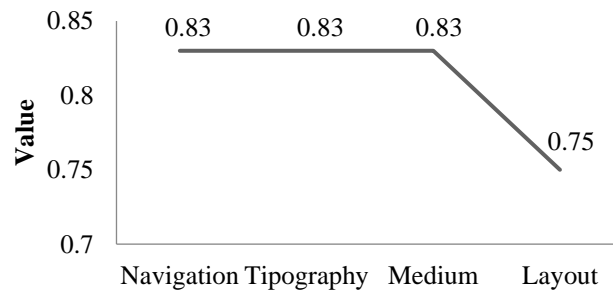


Fig. 3. Audio and Visual Communication Display Validation

The validity value for each audio and visual communication display assessment indicator is shown in Figure 3. The validity values obtained are 0.83 for navigation, 0.83 for typography, 0.83 for medium, and 0.75 for layouts. According to the results, the validation value of the display of audio and visual communication is an average of 0.83, indicating that the category is valid.

Figure 3 depicts the outcomes of validating audio and visual communication displays. The navigation assessment indicators, namely navigation on the developed learning media, are functioning properly and can assist in the proper use of learning media. The results obtained from the use of type and size of letters in the developed learning media are correct in the typographical assessment indicators, and the color combination used is appealing. The media assessment indicators (icon sound, images, animation) obtained from the developed learning media contained animation, audio, and pictures, as well as clear illustrations, and aided and supported learning. The results of the layout assessment item show that the design of this learning media is proportional and appealing.

According to the description above, the developed learning media already includes the assessment items required in the development of learning media. The criteria in the assessment indicators are also in accordance with the Ministry of National, so that the display of audio and visual communication is consistent with the teaching concept guidelines. This is consistent with the findings of the study, which classified audio and visual communication display aspects as valid.

The third component is the learning design, which includes seven assessment indicators such as titles, competences, indicators, learning content, task, evaluation/simulation, and editor. Figure 4 shows the validation results for this learning design.

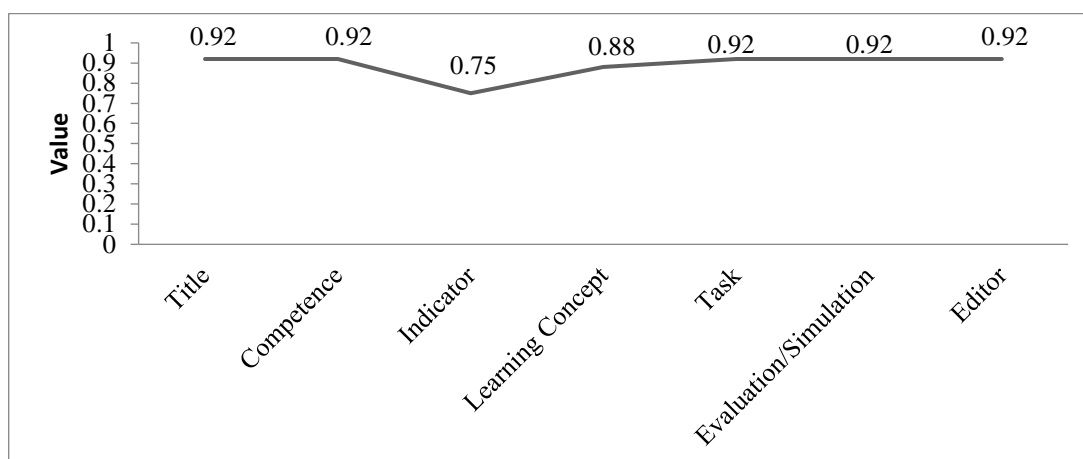


Fig. 4. Learning Design Validation

The validation results of the learning design on simple harmonic motion are shown in Figure 4. The obtained results are 0.92 ; 0.92 ; 0.75 ; 0.88 ; 0.92 ; 0.92 with an average of 0.88 in the valid category. According to the data in Figure 4, the title assessment indicator is that the title presented in the learning media corresponds to the content of the learning media. The Competence assessment indicators show that there are Competence that are in accordance with the Content Standards in the interactive learning media developed. Items for evaluating indicators and learning objectives demonstrate that the indicators presented in learning media are consistent with competence, and the learning objectives in interactive learning media are consistent with the indicators. The learning concept presented was found to be in accordance with Competence in the concept assessment items, and there were examples of questions accompanied by discussion in each sub-concept contained in the learning media so that students could better understand the learning concept. The evaluation questions on the evaluation/simulation assessment indicators are discussed in the results acquired on the developed learning medium, and they are in conformity with the concept offered. In learning media, there is also a constituent identity.

Based on the results, it is clear from this learning design that indicators are required for the development of this learning media. The presented indicators aided in the preparation of learning concepts, where this learning media was designed in such a way. Based on the validation results, the learning design aspects are classified as valid.

Fourth, there are three assessment indicators for software utilisation. Interactivity, supporting software, and originality are all assessment indicators. Figure 5 shows the product validation results for learning design.

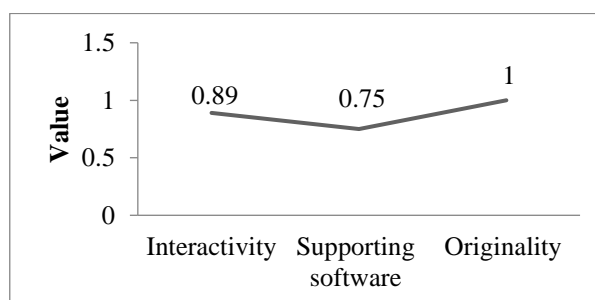


Fig. 5. Learning Design Validation

Figure 5 shows the outcome of testing software on simple harmonic motion concepts. The interactivity score is 0.89, the supporting software score is 0.75, and the originality score is 1. The average of these three assessment indicators is 0.86, implying a valid category. Figure 5 depicts the results of evaluating aspects of software utilization. The assessment indicators in the developed learning media include interactivity (feedback from the system to the user), supporting software, and originality. The learning media has motivation in the interactivity assessment indicator, which can arouse students' motivation in learning, and the content on evaluation questions can provide feedback for students, which can actively reconstruct student knowledge. The supporting

software assessment points demonstrate that the developed learning media can be accessed via a computer, laptop, or smartphone, and that the developed learning media can function properly.

Based on the findings of the preceding elaboration, it is clear that the software used in this learning medium was effective. Furthermore, this learning media is simple to use because it can be used on computers, laptops, or smartphones, allowing students to participate in their learning and access it from anywhere. The validation results obtained through the use of this software have been classified as valid.

Fifth, assess critical thinking abilities. On the aspect of critical thinking skills assessment, six indicators are evaluated. Interpretation, analysis, evaluation, inference, explanation, and self-regulation are among the assessment indicators. Figure 6 shows the product validation results for this aspect.

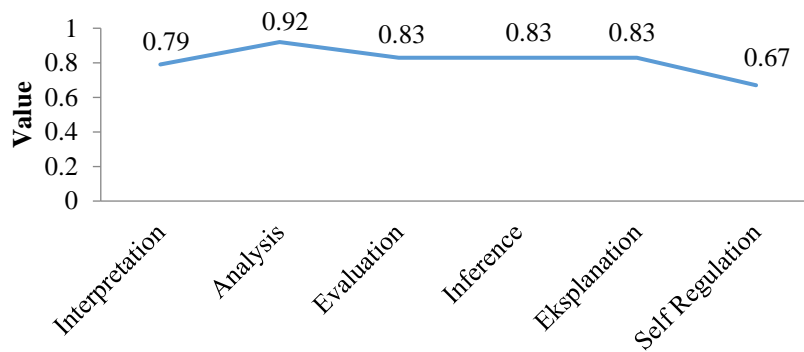


Fig. 6. Validation of Critical Thinking Skills Assessment

Figure 6 shows the outcome of the critical skills assessment validation. Six indicators are evaluated in this assessment. Each indicator has a value of 0.79; 0.92; 0.83; 0.83; 0.83; 0.67, and the total validity of the thinking skills assessment is 0.81, with a valid category. Figure 6 depicts the assessment results on the assessment aspect of critical thinking skills. The first assessment indicator is interpretation; learning media stimulates students so that they can write down the meaning of the problem clearly and precisely. This learning media also directs students to be able to write clear and precise answers to questions. The analysis assessment indicators yielded results, and the developed learning media required students to connect concepts that could be used in problem solving; additionally, this interactive learning media provided opportunities for students to solve problems. The results of the evaluation assessment indicators show that learning media provide opportunities for students to solve problems. The next assessment indicator is inference; in this assessment indicator, learning media assists students in drawing logical conclusions. The explanatory assessment indicator demonstrated that the developed learning media aided students in writing down the final results of problem solving.

Based on the research results described above, it is clear that the developed learning media has been able to assist students in improving their critical thinking skills. This learning media also includes stimuli, problems, and an illustration aimed at honing students' thinking skills. Validation results for aspects of the assessment of critical thinking skills in the valid category were obtained as a result of the development of this learning media.

Sixth, evaluate the creative thinking skills. Figure 7 shows the results of the assessment of creative thinking skills on simple harmonic motion concepts.

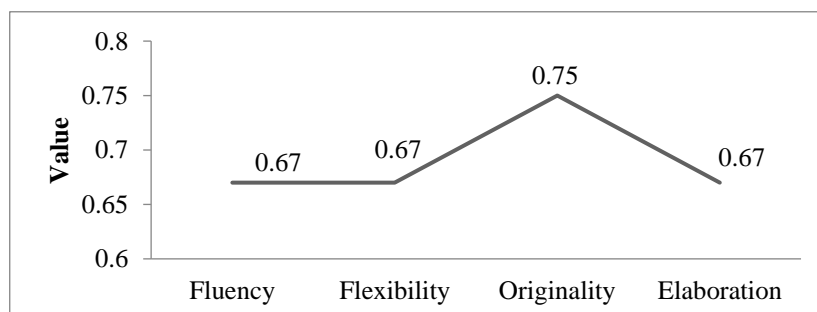


Fig. 7. Validation of Creative Thinking Skills Assessment

The validation result of the assessment of critical thinking skills is shown in Figure 7. Fluency 0.67, flexibility 0.67, originality 0.75, and elaboration 0.67 are the indicators and validation values obtained. With a valid category, the average of the assessment of creative thinking skills is 0.69. According to the data in Figure 7, the assessment results on fluency thinking indicators provided opportunities for students to find diverse ideas. Assessment of indicators of flexible thinking (flexibility), specifically learning media developed to assist students

in solving problems in various way [35]. The assessment of original thinking (originality) results in exposure to new and unique concept presented in the learning media developed [36]. The elaboration assessment indicator demonstrates that learning media can aid in the process of concept discovery in the concept and evaluation presented.

Based on the elaboration of the findings of research on creative thinking skills, it is clear that there are a variety of factors that can assist students in improving their creative thinking skills. This is consistent with the validation results, which show that the learning media developed are valid.

The validity value of interactive learning media products is oriented to critical and creative thinking skills in simple harmonic motion concepts based on the results of validation of concept substance, display of audio and visual communication, learning design, software utilisation, assessment of critical thinking skills, and skills assessment. The average validity of the learning media concept for simple harmonic motion is 0.83, placing it in the valid category.

Table 3. Validity of Interactive Learning Media

Assessment Aspects	Validity Value	Category
Concept substance	0,81	Valid
Audio and visual communication displays	0,83	Valid
Learning design	0,88	Valid
Utilization of software	0,85	Valid
Assessment of critical thinking skills	0,81	Valid
Assessment of creative thinking skills	0,77	Moderate
Mean	0,83	Valid

Table 4 shows the average outcome of each component, which indicates the product's validity. Based on the table above, the product validity value is 0.83 for a valid category. The validation findings reveal that the interactive learning media fits the standards for quality media and includes relevant elements and animations. This media has offered material formulation, indicators, and learning objectives based on competency. This interactive learning media's content has also been fully produced and in compliance with the student handbook, making it easier for students. Furthermore, this interactive learning media considers the compatibility of concept and animation in order to clarify each element of the material that is considered abstract. According to Kusmayadi, learning media can help teachers present material more effectively [37]. Aside from that, it can help pupils understand the content better [38]. As a result, it is critical to pay close attention to the suitability of the material offered in the media. This product will be evaluated for practicality and efficacy in the future so that it can increasingly assist teachers in conveying physics concepts interactively.

IV. CONCLUSION

According to research, instructional media has been recognized valid, which means it can be used in the classroom. The learning media created are in accordance with the needs of the students and the curriculum, and they meet the standards for creating appropriate learning media. This research has the implication that learning material can then be examined for practicality and effectiveness.

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