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Development of Critical and Creative Skills-Based Interactive Learning Media for High School Physics Learning

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ABSTRACT

Science and technology, which continue to experience development in education at the school level, raise demands and improvements in the learning process. In the 21st century, critical and creative thinking skills are needed for students. Therefore, interactive learning media are developed to make students more active and can make improvements to students' critical and creative thinking skills. The development of interactive learning media aims to create interactive learning media based on critical and creative thinking skills on valid and practical circular motion material. This study used the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The validation test resulted in the developed interactive learning media obtained a result of 0.78 with a reasonably valid category. The validation results showed that the interactive learning media was not yet valid, so it needed to be revised based on the validator's suggestions to make the product more valid. After revision, the product was declared usable. The results of the practicality test conducted on high school physics teachers in Padang obtained 91% results, indicating that interactive learning media is practical to use. Based on the results of the validation test and practicality test, interactive learning media based on critical and creative thinking skills in circular motion material is declared valid and practical.

Keywords: Interactive learning media, Critical thinking skills, Creative thinking skills

INTRODUCTION

Science and technology experience rapid development every day. This influences education at the school level, giving rise to demands for improvement and refinement of the learning process (Huang et al., 2021; Rahayu et al., 2022; Rahim, et al., 2022). The rapid development of technology, communication, and information is characteristic of the 21st century (Mardhiyah et al., 2021; Umayah et al., 2020; Wijaya et al., 2016). There are skills that students must master so that education can prepare students to master various skills to become successful people for life in the 21st century (Sumantri, 2019). The skills that a person must have to face the 21st century are called 4C skills, which include critical thinking/problem-solving, creativity, communication, and collaboration (Ibrahim et al., 2017; Asrizal et al., 2022). Critical and creative thinking skills are components of 21st-century skills.

The government has implemented various programs and policies to support learning critical and creative thinking skills by developing the revised 2013 curriculum (Krisna et al., 2020; Sari et al., 2022a). The 2013 curriculum contains student-centered learning processes that are appropriate to the 21st-century learning system. Student-centered learning processes are learning processes that can make students creative, innovative and think critically. Students

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can connect learning through contextual problems in everyday life (Zubaidah, 2016). For this reason, it is necessary to develop learning media that can provide demands for students to think critically and creatively by utilizing technology.

Teachers must also design creative and innovative learning to create creative and innovative learning processes. Teachers are expected to be able to develop skills in making their own learning media because the development of science and technology is increasingly giving impetus to the direction of renewal (Tafonao, 2018). Interactive learning media is a technology in learning. Interactive learning media is a tool teachers use to help students understand the subjects they are studying. When used, the media encourages students to interact with each other, namely between the media and students, and produces a reciprocal reaction. One option for implementing student-centered learning following the 2013 curriculum is through interactive learning media.

Real conditions show that teachers have not maximized the use of interactive media in the learning process. Based on observations made by distributing questionnaires to teachers in several high schools in Padang City, it can be seen that of the 93% of teachers who have used interactive media, only 43% of teachers can make their own interactive media. This data indicates that teachers have not been able to develop their own interactive media. According to Setiawan and Purnomo (2016), the teacher's obstacle in developing interactive learning media is that they lack mastery of learning technology, making it difficult to develop material in learning media. Another research by Marsa (2020) explains that out of 8 teachers, only 3 teachers use instructional media, not even interactive, namely using PowerPoint. At this time, rapid innovation is needed in the world of education and is a top priority in the development of the education system, especially in the manufacture of learning media (Rahim, et al., 2019). The problems faced by teachers in making interactive learning media tend to be the same, namely the low ability of teachers to operate media in the learning process in the classroom, not enough time that teachers get to make learning media, especially IT-based, that is appropriate to the material to be taught. Based on the data analysis, it is concluded that teachers have not mastered learning technology to develop interactive learning media.

The results of the analysis of interactive physics learning media used by teachers in several public high schools in Padang show that in terms of audio and visual communication, the score is 53%. Then from the aspect of learning design, a percentage of 51% is obtained. Based on the analysis results, teachers' quality of interactive physics learning media still does not meet the criteria for good interactive learning media. This is reinforced through the results of interviews with teachers at one of the public high schools in Padang, which can be concluded that the use of learning media is commonly used in PowerPoint. The interactive learning media used is an interactive simulation of PhET Simulation, but it is still not maximally used in learning. From these conditions, interactive learning media still needs to be developed for physics learning at Public High Schools in Padang.

Observations were also made to class X students at several public high schools in Padang regarding learning styles, interest in interactive learning media, and critical and creative thinking skills. Based on the results of student analysis, it can be concluded that students find it difficult to understand physics lessons, enjoy audio-visual learning, have a high interest in understanding physics material through interactive learning media, and students' critical and creative thinking skills are still not high. In learning physics, students are active learners, while teachers are expected to understand the conditions of students so that they can teach according to the characteristics and development of students (Chodijah, 2012). Sapriosma (2008, cited in Syafi'I, 2016), explains that learning physics requires an understanding of concepts because the material is abstract and difficult to understand and sometimes observe. Circular motion is a physics material that is difficult to learn because there are equations in it, so it will be difficult for students to understand the concepts and

phenomena of circular motion. Interactive media can help explain circular motion phenomena that require further explanation (Desy et al., 2015).

The physics interactive learning media used by the teacher are still not following the criteria for good interactive learning media, while students enjoy interactive learning media in the learning process. If the teacher is not innovative in developing learning media, it will impact student learning outcomes (Dwiqi et al., 2020). According to Mayer 2002 (cinted in Hendi et al., 2020), students' critical thinking skills can be developed by using instructional media. Choosing the right learning media can determine the success of developing students' critical thinking skills. Furthermore, interactive learning media can improve students' creative thinking skills (Rachmawati et al., 2020). Based on these conditions, it is hoped that there will be interactive physics learning media that meet the criteria of good interactive teaching media.

One of the criteria for interactive learning media is the audio-visual aspect. In this learning media, there are interesting writing, pictures, and animations so that students are more interested and motivated in understanding physics material, especially circular motion material. Interactive learning media also contains interactive aspects to increase students' active participation during learning. In addition, interactive media content also contains content that can train students' critical and creative thinking skills in the physics learning process so that the interactive physics learning media that is developed refers to student characteristics and can train students' critical and creative thinking skills.

Previous research by Arbaun and Lolowang (2021) on the development of interactive learning media using Lectora Inspire on Newton's law material about motion is considered appropriate as a learning medium. However, it has not yet integrated critical and creative thinking skills. Furthermore, research by Wahyuni et al. (2022) states that interactive learning media is based on articulate storylines in science learning on the solar system material is very practical and can improve students' critical thinking skills. However, this research has not integrated creative thinking skills. Then research by Ridwan et al. (2021) shows that the developed interactive learning media is valid, effective, and efficient in improving students' physics creative thinking skills. However, interactive learning media only integrates creative thinking skills.

This research develops interactive learning media using the applications Lectora Inspire and integrates aspects of critical and creative thinking skills in learning media, especially in the examples of questions presented to train students' critical and creative thinking skills, especially in circular motion topics. The research aims to develop interactive learning media based on critical and creative thinking skills on valid and practical circular motion material. The novelty of this research is the integration of aspects of critical and creative thinking skills in the developed interactive learning media. In addition, using the application Lectora Inspire as a platform for developing interactive learning media is also a novelty in this research because the application has various features that make it possible to develop interesting and interactive learning media.

METHODS

This study used research and development methods using the ADDIE model. The ADDIE model has five stages: analysis, design, development, implementation, and evaluation. The stages of research using the ADDIE model are connected and can be used according to the needs of researchers (Rayanto, 2020). This study aims to produce interactive learning media products based on critical and creative thinking skills using the application Lectora Inspire for high school students. The resulting product will be tested for validity and practicality. This study focuses on examining the validity and practicality of interactive learning media based on critical and creative thinking skills. The product validity test was

conducted by three experts, namely Physics Education lecturers at Universitas Negeri Padang. The practicality test was limited to product practicality tests for physics teachers at several public high schools in Padang. The selected samples were senior high school X, senior high school Y, and senior high school Z.

The validity test of the product used the validity sheet of interactive learning media, which had previously been tested for the validity of the instrument sheet. The instrument sheet was validated by three experts as instrument validators. The instrument validator was a lecturer in Physics Education at Universitas Negeri Padang. The instrument sheet consisted of question items using a Likert scale of 1 to 5, where each scale described strongly disagree, disagree, neutral, agree, and strongly agree. The assessments of three experts were analyzed using the Aiken index formula. The instrument was revised again according to the instrument validator's suggestions to achieve validity. After revision, the instrument was ready to be used to assess the product. In addition to developing validity instruments, practicality instruments were also used. The practicality instruments developed are instruments that have been developed by previous researchers and modified according to research needs.

The product was evaluated by three experts who acted as product validators. The components assessed consisted of 6 aspects: material substance, audio and visual communication display, learning design, software utilization, critical thinking skills, and creative thinking skills. The results of the validator's assessment will be calculated using the Aiken index formula. The results of the Aiken validity index were then converted into the Aiken validity criteria, namely $V \leq 0{,}4$ (low), $0{,}4 < V < 0{,}8$ (medium) dan $V \geq 0{,}8$ (high) (Retnawati, 2016). After the product was assessed, the product was tested for practicality by high school physics teachers. The aspects assessed for practicality were ease of use of interactive learning media, attractiveness, and efficiency.

RESULTS AND DISCUSSION

Results

This research was carried out by going through stages according to the research model used. The stages of analysis carried out are needs analysis, student characteristics analysis, and curriculum analysis. Needs analysis is reviewed from the availability of interactive learning media in schools. Based on a questionnaire given to physics teachers at several public high schools in Padang, it is concluded that teachers have used interactive learning media but have not fully made the interactive learning media themselves, and questions that contain critical and creative thinking skills are also lacking in interactive learning media. Analysis is carried out on presentation media PowerPoint used by teachers in schools. The analysis results of the interactive learning media components can be seen in Table 1.

Table 1. Analysis of Interactive Learning Media at Several Public High Schools in Padang

Name	Percentage
Material substance (content)	71 %
Audio and visual communication display	53 %
Learning design	51 %
Software utilization	73 %

The weakness of the interactive learning media teachers use is in terms of audio and visual communication display and learning design, which is not optimal. The indicator of the

components of audio and visual communication display in question are: 1) 33% still use basic navigation on interactive learning media to function properly; 2) proportional accuracy between font size and slide space is still 45% on interactive learning media; 3) accuracy of illustration quality in the form of images and animations in terms of placement, size and color are still 49% in interactive learning media; 4) only 32% of videos presented in interactive learning media are following learning material. Then, in the learning design component, there are problems, including: 1) the conformity level is only 40% in the formulation core competence, basic competence, indicators and learning objectives, and only 47% of the questions presented in interactive learning media have not been discussed. Furthermore, student characteristics regarding learning style, interest in interactive learning media, and critical and creative thinking skills are analyzed.

From the analysis, it is found that students enjoy learning using audio-visual, have a high interest in learning to use interactive learning media, and are not yet fully able to think critically and creatively. Finally, curriculum analysis is carried out based on the 2013 curriculum, which refers to Regulation of the Minister of Education and Culture of Indonesia number 24 of 2016 concerning Core Competencies and Basic Competencies. Competency achievement indicators, material coverage, and learning objectives are based on core and basic competencies. The results of the curriculum analysis show that circular motion material is contained in the basic competencies 3.6 and 4.6 in Class X Semester 1. The scope of material for circular motion is the phenomenon of circular motion in everyday life, the magnitudes in a circular motion, uniform circular motion, circular motion change order, and the relationship of the wheels.

The design stage begins with determining the application to develop interactive learning media. The application used is Lectora Inspire because this application has several advantages, namely ease of use, has interactive features, so this application is suitable for developing media. After determining the media, the presentation of the material is arranged according to requirements such as image, animation, and equations, which follow circular motion material. Before these elements are entered into the application, the storyboard or the framework of the media to be developed is designed in advance. Afterward, the elements are inserted into the application according to the design on the storyboard. This interactive learning media focuses on critical and creative thinking skills, which will focus on questions that contain critical and creative thinking skills.

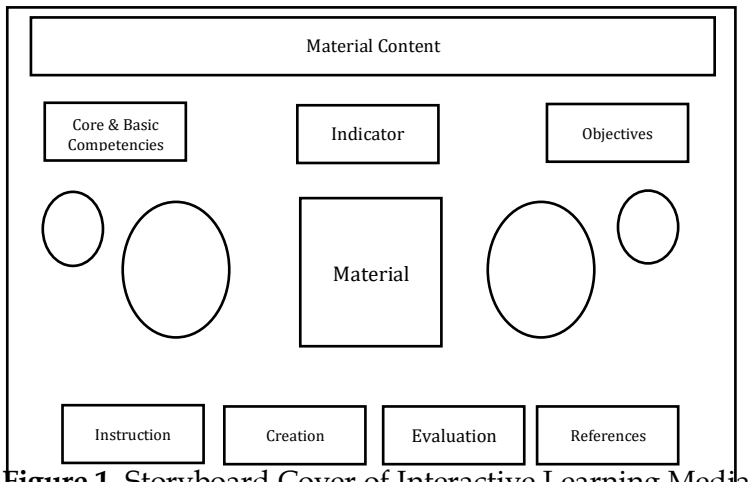

Figure 1. Storyboard Cover of Interactive Learning Media

Figure 2. Cover Design of Interactive Learning Media

The development stage is the stage for creating valid product-developed results. After the product is ready to be designed, then the product will be tested for validity. Three validators have carried out the assessment using interactive learning media validation instruments. The instrument used has been validated with a value of 0.77 in the medium category. Furthermore, the instrument is used to assess the product, which is carried out by experts. After the assessment is carried out, the results will be used as a basis for revising the product that has been developed. This revision stage is carried out to ensure that the resulting product is valid and can be used properly for the learning process. In addition, the revision stage is also carried out to optimize product quality to suit user needs, both in terms of material, appearance, and the features provided. After the product has been successfully revised, the next stage is the implementation and practicality testing of the product before finally being implemented by teachers and students in schools. The results of expert validation on the product can be seen in Table 2.

Table 2. Validity Test Results

Aspect	Average	Category
Material Substance	0.87	Valid
Audio and Visual Communication Display	0.74	Medium
Learning Design	0.85	Valid
Software Utilization	0.90	Valid
Critical Thinking Skills	0.65	Medium
Creative Thinking Skills	0.67	Medium

The material substance aspect is reviewed from three assessment indicators: the correctness of the material's content, presentability, and readability. The aspect of audio and visual communication display is assessed from indicators of navigation, typography, media (icons, sounds, images, and animations) and layout. The aspect of learning design is assessed based on the title, core competencies, and basic competencies, indicators and learning objectives, material, sample questions, evaluation or simulation, and compiler. The aspect of software utilization is seen from interactivity in the form of feedback from the system to users, supporting software, and originality. The aspect of critical thinking skills is seen based on indicators of interpretation, analysis, evaluation, interference, explanation, and self-regulation. While the aspect of creative thinking skills is assessed based on indicators of fluency, flexibility, originality, and elaboration.

The validation results show that there are still aspects with medium criteria. To achieve valid criteria, revisions are made regarding indicators that were not yet valid from each aspect. In the aspect of audio and visual communication display, the validators suggest that media settings such as icons, images and animations be improved to be more proportional because previously, some images and animations do not appear. This is due to an error in the syntax settings on the application. After repair, the audio and visual communication display has been declared valid. Furthermore, in the aspect of critical and creative thinking skills, there are still several evaluation questions that have not appeared. The product is revised according to suggestions from the validators.

The implementation stage is continued after revisions have been made according to the validator's suggestion. The implementation stage is carried out by testing product practicality. The practicality test is carried out on each of two physics teachers from three high schools in Padang, including senior high school X, senior high school Y, and senior high school Z. Practicality is reviewed from 3 aspects, namely 1) ease of use, 2) attractiveness, and 3) efficiency. Furthermore, the data will be processed and analyzed to determine whether the product is suitable for learning. If the analysis results show that the product meets the expected practicality criteria, then the product can be used in classroom learning. However, if the results of the analysis show weaknesses or deficiencies in the product, it is necessary to carry out further revisions to improve the product before it is widely implemented. Practical results are presented in Table 3.

Table 3. Practicality Test Results

Aspect	Average (%)	Category
Ease of Use	88	Very Practical
Attractiveness	93	Very Practical
Efficiency	93	Very Practical

The aspect of ease of use includes material, sample questions, evaluation, the use of written spelling and language contained in interactive learning media that is clear and easily understood by teachers and students. The attractiveness aspect means the material's color composition and completeness can attract students' attention to study physics. The aspect of efficiency includes the time needed to learn to use interactive learning media is not long, and its use does not require relatively high costs. The results of the practicality test, which show an average score of above 80 in each aspect of the assessment from each school, confirm that this interactive learning media is indeed very practical to use in the learning process. The aspect of ease of use that is clear and easily understood by teachers and students, attractiveness that can attract students' attention, and manageable time and cost efficiency are important factors in supporting the practical use of this interactive learning media. The practicality test results for each school can be seen in Table 4.

Table 4. Practicality Test Results for each school

School	Aspect		
	Ease of Use	Attractiveness	Efficiency
School X	84	85	90
School Y	92	100	98
School Z	88	95	92

The practicality results show the average of each response per each school based on the aspect being assessed. The results showing a value of 81-100 are in the very practical category. From the results of the practicality test, it is obtained that all scores are above 80, so this interactive learning media is very practical to use. Based on these results, the interactive learning media is easy to use in the learning process for both teachers and students, attractive in terms of appearance and content, and efficient in terms of time and cost use for teachers and students. Based on these results, the interactive learning media, revised according to experts' suggestion and tested practically on six physics teachers from three public schools in Padang, is very practical to use in learning activities. Therefore, this interactive learning media is expected to be one of the solutions to improving the quality of learning in schools.

The evaluation stage is carried out at each stage that is passed, especially at the design and development stage. When the design stage is evaluated regarding the product's prototype, whether the product can be tested for validity. At the development stage, evaluation is carried out by revising the product according to the validator's suggestions after the product is assessed. Evaluation is basically carried out to review the steps in the research, whether they are going well or not. The evaluation also aims to find weaknesses at each stage to correct them quickly. In addition, evaluation also ensures that the resulting product meets predetermined quality criteria. The evaluation results will be a reference in deciding whether the product is suitable for use or needs further improvement and development. By conducting periodic evaluations, the resulting product is hoped to have good quality and meet user needs.

Discussion

Physics is a learning that requires further explanation to be understood. Some physics materials are not easily related to everyday life in human life (Malina et al., 2021). For this reason, educators must be creative in developing learning media so that students can understand the material to be conveyed and are interested in studying physics (Miswati et al., 2020). Learning media is used as a thing that has a very big influence on learning activities. Learning media is a technology that can be used as a messenger for educational purposes so that students are interested in the subject matter (Astuti & Nurmasitash, 2018).

One type of learning media is interactive learning media. Interactive learning media means that there is an element of reciprocity between the user and the media. Interactive learning media has a very important role in delivering physics material. By utilizing technology that is developing rapidly, teachers can utilize various kinds of technology to develop interactive learning media. Along with the development of time, various kinds of demands must be mastered by students to live and compete in the future (Sofyan, 2019). In the 21st century, individuals in an information and technology society are expected to have high-level skills such as critical thinking, decision-making, communication, creative thinking, and problem-solving rather than content-oriented teaching and talent development processes (Turhan & Dermici, 2021). By utilizing technology, teachers can develop interactive learning media that integrate critical and creative thinking skills as demands of the 21st century.

The initial research conducted is need analysis, student characteristics, and curriculum. This analysis is needed to determine the possible causes of gaps in learning (Branch, 2009). The results of the analysis stage research show that the use of interactive learning media used by teachers is still not maximally fulfilled, while students enjoy learning using interactive learning media. This can be seen from an analysis of the learning media used by teachers who have not fulfilled the components of interactive learning media. The criteria assessed are from the aspects of material substance, audio and visual communication display, learning design, and software utilization. Low results are shown in the aspects of audio and visual communication display and learning design. In the aspect of audio and visual communication display, there are several components such as navigation, proportional letters and slides,

quality of illustrations, audio, and animation. These components are still not optimal, and they are not there in some media. Without audio, pictures, and illustrations according to the material, students will have difficulty and be less interested in learning physics.

In the aspect of learning design, the complex components are the suitability between core competencies, basic competencies, indicators and learning objectives with the presentation of material in learning media that is still not well connected. If the suitability between competencies, indicators, and learning objectives is not well connected, the elaboration of the material will be difficult for students to understand. Furthermore, the questions that contain critical and creative thinking are still lacking compared to the practice questions on the media. This will make students not used to working on critical and creative thinking questions. Based on this, there is still a gap between learning between teachers and students. These results are used to develop interactive learning media and follow good criteria and contain critical and creative thinking skills.

The study of the initial design includes the preparation of applications, materials, pictures, and animations. The design stage aims to match the planned product and the methods for testing that match. At the design stage, interactive learning media products began to be developed. The application used is Lectora Inspire, with the consideration that this application is easy to use even for beginners. Lectora Inspire does not require a complicated programming language to be learned by beginners (Shalikhah et al., 2017). After that, the concept of interactive learning media that is made is designed in a storyboard. Materials regarding circular motion are arranged to be included in the media. Sub-material that is not sufficiently explained by writing, assisted by pictures and animations. The product developed integrates critical and creative thinking skills, and the material preparation focuses on the content of questions that can provide practice for students to think critically and creatively. After the preparation of images, animation, writing, and critical and creative thinking questions is completed, it is transferred to the application so that the prototype product has been completed.

The development stage is carried out to assess the quality of the product and whether it is suitable for use. Product quality must be identified immediately after finishing the product (Muktiani et al., 2021). Product evaluation is carried out by giving a questionnaire in the form of a product validation sheet to three experts. The results of the validation show that there are still various aspects that must be revised according to the validator's suggestions. An evaluation is needed to improve the product so that it is more valid. The items' contents must be carefully evaluated according to expert's suggestion (Fraenkel et al., 2013). Valid interactive learning media can affect student learning. One of the influences of interactive learning media on students is critical thinking skills. Previous research concludes that there is an increase in students' critical thinking skills (Zulhelmi et al., 2017). Other studies have also shown that interactive learning media, and tutorial models, have a significant effect on students' critical thinking skills (Komara et al., 2017; Sari et al., 2022b).

Products revised according to experts' suggestions will be tried out in schools by giving practicality questionnaires to teachers to assess the practicality of using this learning media. The teacher respondents are six physics teachers consisting of 2 teachers from each of the three public schools in Padang. After collecting practicality questionnaires from physics teachers in three public schools in Padang, the results will be analyzed to evaluate the practicality of using the product, which has been revised according to experts' suggestion. Furthermore, the results of this analysis will become the basis for further improvement and development before the final product is used in learning. The teacher's response to interactive learning media shows that the product is practical for learning activities. Practical, interactive learning media includes indicators of ease of use, time efficiency, and attractiveness (Yanto, 2019).

This interactive learning media can be accessed online through a website link; some of

the content contained in this media is material and interactive quizzes that can assist students in understanding physics in circular motion material. Teachers and students can easily access media using sophisticated technology (Bunyamin et al., 2020). Several circular motion phenomena are presented in interactive learning media to make it easier for students to understand the material. The questions presented in the evaluation also guide students to think critically and creatively. This learning media can be used by students when studying and can hone critical and creative thinking skills. Presenting interactive learning media can encourage students to think critically (Al-Mar'ati et al., 2021). Other studies have also shown that interactive content in the learning process can increase creative thinking skills (Adawiyah et al., 2019).

The developed interactive learning media integrates indicators of critical and creative thinking to train students' critical and creative thinking skills. The novelty of the research developed is integrating critical and creative thinking skills in learning media on sample questions and evaluation questions adapted to critical and creative thinking indicators. Furthermore, media development uses the application Lectora Inspire with material of physics, namely circular motion. The limitation of this research is that it is only tested at the practicality stage for teachers. It is hoped that in further research, it will be possible to test the effectiveness of the learning media that has been developed so that the product is even better. In addition, the learning media developed must be accessed online, requiring a network.

CONCLUSION

The development of interactive learning media has an important role in learning. The need for interactive learning media has led to the development of an interactive learning media based on critical and creative thinking skills on circular motion material for senior high schools. This media is developed using the application Lectora Inspire. The advantage of the product is that it can be used as a means to train critical and creative thinking skills. This media is available online, so it does not require storage space to download. The results of the validation and practicality conclude that this interactive learning media is valid and practical to use in learning activities.

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