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Interactive video for learning Mathematics element of measurement in elementary school

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ABSTRACT

Mathematics learning needs to be delivered using learning media to make it easier for students to receive information and increase student motivation. Creating interesting learning media is the solution to make it easier for students to receive the material. This research aims to produce an interactive video for learning elementary school measurement math that can motivate students to learn. The method used in this research is development research with the Lee and Owen development model. The development model consists of 5 stages: analysis, design, development, implementation, and evaluation. The validation results showed positive results that are very feasible to use. The trial in the actual class has been proven by the student's response to using the developed media, which is seen in ease, attractiveness, and motivation. Developing interactive videos can be considered accessible, exciting, and motivating for elementary school students to learn.

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ABSTRAK

Pembelajaran Matematika perlu disampaikan dengan menggunakan media pembelajaran sehingga memudahkan peserta didik dalam menerima penyampaian informasi serta meningkatkan motivasi peserta didik. Pembuatan media pembelajaran yang menarik menjadi solusi yang ditawarkan untuk mempermudah peserta didik dalam menerima materi. Penelitian ini bertujuan untuk menghasilkan interaktive video untuk pembelajaran matematika elemen pengukuran sekolah dasar yang dapat memotivasi peserta didik untuk belajar. Metode yang digunakan dalam penelitian ini adalah penelitian pengembangan dengan model pengembangan Lee and Owen. Model pengembangan terdiri dari 5 tahapan analisis, desain, pengembangan, penerapan, dan evaluasi. Hasil validasi menunjukkan hasil positif sehingga media sangat layak untuk digunakan. Uji coba pada kelas sebenarnya telah dibuktikan dengan respons peserta didik terhadap penggunaan media yang dikembangkan dilihat dari aspek kemudahan, kemenarikan, dan motivasi. Pengembangan interaktif video dapat disimpulkan mudah, menarik, dan memotivasi belajar peserta didik sekolah dasar.

Kata Kunci: *Elemen pengukuran; Matematika; sekolah dasar; video; video interaktif*

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INTRODUCTION

Mathematics learning needs to be delivered using learning media so that it is easy for students to receive the delivery of information. Mathematics must be taught easily to be well-received and enjoyable (Maswar, 2019). Mathematics learning should be fun to provide strong learning motivation for students to learn again. Mathematics has an important role in everyday life, so it needs to be studied well by students, as conveyed by Ernawati *et al*., in their book entitled "*Problematika Pembelajaran Matematika"*. Mathematics is used to develop logical thinking skills, so teaching it as early as possible is important.

Based on interviews and observations in elementary schools with educators who teach Mathematics, it was found that some Mathematics materials are difficult for students to understand, including the material on area and circumference for the elementary school level. Most students do not understand the concept of the area and circumference of shapes. In addition, the tendency for not all students to follow the learning well because of low learning motivation causes unsatisfactory learning outcomes. In implementing learning in the classroom, educators prioritize traditional learning methods. The implementation of learning prioritizes working on questions that are solved using formulas. Whereas according to Żądło-Treder (2021), Mathematics learning, especially for children, cannot be based only on symbols. This causes low learning motivation in students because they do not understand the concept of Mathematics for everyday life.

Based on the information presented above, the application of learning media is important to motivate students. Media can help students develop thinking skills. Communication and information delivery can be easily done with the help of learning media (Degeng *et al*., 2021). Video media is an alternative to support the learning process by motivating students (Khairani *et al*., 2019). The application of video media for learning is expected to present a learning process that motivates students so that it can maximize student learning outcomes. At least in Mathematics learning, educators can provide different interventions so that it is no longer emphasized on solving problems, but more on the concept of Mathematics.

Video media for learning can eliminate the boundaries of space and time in the context of learning, involving providing more flexible and easier access to education (Gafur *et al.,* 2023). With the right visual aids and narration, learning videos can provide better explanations than images or text alone. This helps students understand concepts better because they can see the process before their eyes. For example, the concept of an area can be explained with the example of a football field by providing additional visual explanations. Visual learning videos are better than educators' explanations in traditional classrooms. However, with videos, this process can be recorded and presented visually. Students can see the concept of Mathematics clearly without imagining further (Hiwarekar, 2023). In addition, video media is still relevant in these times. Visual appeal, real or unreal, is important in implementing video for learning.

Visual appeal is important in influencing children's interest and attention in something. Children tend to be attracted to attractive, cute, and adorable images, colors, and designs. Visual beauty attracts their interest and attention because they have not fully developed their abstract thinking skills. Characteristics such as bright colors, simple shapes, and cute facial expressions are the main factors that make something visually appealing to children. Children will be more interested in interacting with a character or object with a strong visual appeal. This phenomenon has significantly developed in today's era, including the virtual YouTuber (VTuber) concept. VTuber uses digital avatars or animated characters designed by considering the principles of visual appeal with the help of technology (Ferreira *et al.,* 2022). These characters often have cute, adorable designs, with bright colors that attract attention. Not only that, VTubers also take advantage of this visual appeal by presenting content that is entertaining and interesting for children. They create fun interactions between their characters and young viewers. By combining strong visual appeal with content that suits children's interests, VTubers have become one of the most popular forms of entertainment among the younger generation. They offer an interactive and fun experience, while still paying attention to

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values and standards appropriate for children's ages. With the advantages and interests of animation that all ages can accept, of course, VTubers will be interesting to continue to be developed in the context of learning media (Saputra & Setyawan, 2021).

However, conventional videos do not provide interactivity to their users, so users feel uninvolved in the instruction process. So, it is necessary to add interactivity features, considering that interactive videos have more significant potential to motivate students to understand the concept of mathematics. Therefore, the developed media for learning is interactive video to support student involvement in learning. The positive relationship between interactivity and the appropriateness of the use of interactive video is very influential (da-Costa *et al*., 2021). Interactive video media provides a different learning experience from conventional videos. Interactive video helps facilitate video learning that includes explicit instructional elements such as eliciting responses, offering supportive practice, providing immediate affirmative and corrective feedback, and monitoring learner performance.

Interactive video learning media needs to be designed to maximize learning. So that the media developed can focus on mathematical concepts, especially measurement elements, to increase learning motivation by providing different experiences for students in learning. According to Rachmavita (2020), interactive media based on animated videos can increase students' motivation to learn mathematics. The purpose of providing interactive videos is to motivate students to learn. The application of interactive videos includes using real and unreal visuals presented in the material. Interactivity in videos is a computation that is designed in such a way that media and users can interact. The interactive features in videos include buttons, pop-up info, branching, data collection, and quizzes. Interactive features in interactive videos change students' habits in watching learning videos to become more involved (Wang, 2021). The study results show that video quizzes successfully create an engaging and interactive mode of content delivery (Cummins *et al*., 2016). The result of this interactivity process is in the form of user responses to the media. By providing interactivity, students can feel directly involved in the learning process. Other research results state that media for learning that provides interactivity in learning can motivate students to learn (Harsiwi & Arini, 2020; Kusumawati & Mustadi, 2021; Mawaddah *et al*., 2019; Octafiana *et al*., 2018; Purnomo & Sujatmiko, 2022). The study's results became the basis for researchers who learned that learning media that support interactivity in learning can provide an effective learning process. Based on the explanation above, this study aims to produce interactive videos, especially on measuring flat shapes by emphasizing flat shapes (Square, Rectangle, and Triangle) and showing how to calculate the circumference and area. The interactive video is expected to be a product that can motivate students to learn Mathematics, especially in the measurement element. The quizzes given to students will require students to listen and complete. Development is carried out by knowing the results of student responses to the media.

LITERATURE REVIEW

Videos for Learning

The use of video in learning contexts has become an increasingly relevant research subject in modern educational literature. Previous studies have explored various aspects of using video effectively to support learning. One aspect emphasized in previous studies is the ability of video to present information visually. According to Apriadi (2021), images and animations in videos can help students understand abstract concepts in science better. Similar findings were also reported by Fauzi *et al*. (2022), highlighting the importance of visualizations in videos to enhance students' understanding of complex mathematical concepts. In addition, the use of sound and narration in videos has also been a significant focus of research. According to a study by Indriani (2019), A narrative delivered clearly and experienced can improve students' understanding of the material presented in the video. Similar results were found in

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research by Busyaeri *et al*. (2016), who found that using a persuasive voice can increase student engagement in the learning process.

The use of video has also been shown to increase student engagement and motivation. Animation and visual effects in videos can increase student interest in the material being taught and reduce boredom levels during the learning process (Ammy & Wahyuni, 2020). Videos can strengthen students' learning motivation (Tse *et al*., 2019). Overall, this literature review confirms that video use in learning has several significant benefits. By presenting information in a visual, auditory, and interactive way, video enables more effective and engaging learning for various users.

Interactive Video

Interactive video combines conventional and computer programs, so the video is not received linearly. Users can interact with the video by choosing their video flow (Wibowo & Thaariq, 2023). The research results on interactivity with media were conducted by conducting cognitive teaching experiments to explore the influence of interactive multimedia learning environments on students' creative thinking abilities (Ridwan *et al*., 2021). Their study revealed that interactive elements embedded in video content facilitate engagement and critical thinking skills among learners, leading to improved creative problem-solving abilities. Similarly, Anggraeni *et al*. (2021) investigated the efficacy of interactive multimedia learning environments in improving children's reading comprehension skills. The findings underscore the effectiveness of interactive videos in promoting active learning and comprehension strategies among learners.

Research by Newman *et al*. (2020) highlights the transformative potential of interactive video in breaking down educational barriers. By providing learners with opportunities for active participation and personalized learning experiences, interactive video can cater to various learning styles and preferences. It also explores the impact of multimedia-based instruction on elementary school students' problem-solving skills and science learning. Their research shows that interactive video, when integrated with relevant learning content, promotes more profound understanding and retention of scientific concepts among students.

Besides that, Loughlin and Cresswell (2021) propose an interactive concept map approach to support learning activities. Their study emphasizes the role of interactive video in facilitating collaborative learning and knowledge construction in mobile learning environments. Interactive video in education fosters critical thinking and problem-solving skills, enhancing engagement and understanding among learners.

Mathematics Elements of Measurement

In the independent curriculum, Kementerian Pendidikan, Kebudayaan Riset, dan Teknologi Badan Standar, Kurikulum, and Asesmen Education groups elementary school mathematics into elements and phases. Each phase in the measurement element, among others, includes the following explanations: At the end of phase A, students can compare the length and weight of objects directly and the duration of time. They can measure and estimate the length of objects using non-standard units. At the end of phase B, students can measure the length and weight of objects using standard units. They can determine the relationship between standard length units (cm, m). They can measure and estimate area and volume using non-standard and standard units as whole numbers. At the end of phase C, students can determine the circumference and area of various flat shapes (triangles, quadrilaterals, and polygons) and their combinations. They can calculate the duration of time and measure the size of angles (Viewed: https://kurikulum.kemdikbud.go.id/wp-content/unduhan/CP_2022.pdf).

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In this development, the developer focuses on phase B. The mathematical approach of measurement elements in phase B of the educational curriculum strongly emphasizes developing students' critical and analytical thinking skills. Students are encouraged to engage in activities that encourage them to analyze information, make reasonable estimates, and formulate and evaluate solutions to complex measurement problems. Through active and problem-based learning, students can apply measurement concepts in authentic contexts, allowing them to see the direct relevance of their learning to everyday life. In addition, phase B also aims to help students develop the ability to use measuring instruments correctly and efficiently and understand the importance of precision and accuracy in making measurements. This helps students to become more confident and skilled in dealing with situations that require measurements in their lives. Thus, phase B of the mathematical approach of measurement elements aims to prepare students with a strong foundation to face the challenges in measurement that they will face in the future.

METHODS

This research is on developing interactive videos for mathematics measurement elements for Sekolah Dasar Taruna Dra. Zulaeha, grade IV. This research uses the Lee and Owen development procedure in their book, "Multimedia-based Instructional Design: Computer-based Training, Web-based Training, Distance Broadcast Training, Performance-based Solutions," shown in Figure 1.

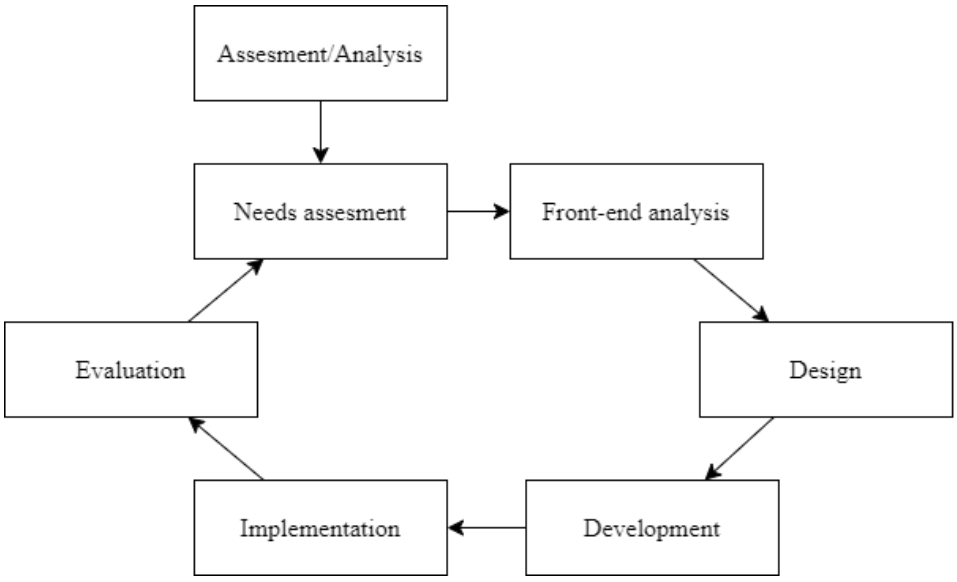

Figure 1. Lee and Owen Development Model
Source: Lee & Owens (2004)

Assessment/analysis stage: There are two stages: need assessment and front-end analysis. (1) The needs assessment stage is an activity to identify the difference between real conditions and ideal needs so that developers can meet these ideal needs. (2) Front-End Analysis stage, overall analysis activities include: User analysis to determine student enthusiasm when given learning media. Technology analysis is carried out to determine the most promising media to be developed based on student needs analysis and user analysis. Situation analysis is carried out to determine the condition of school facilities. Analysis

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of important events is carried out to determine the learning that students will achieve; the important events in question are the curriculum expected at the school. Objective analysis is carried out to determine specific learning objectives. Media analysis is carried out to determine the accuracy of media selection for subjects.

The design stage in this model is very characteristic of the concept of interactive programming development, where, in the content structure preparation stage, an attempt is made to achieve the interactive principles of content that must be in the product—creating a precise flow so that development can be carried out according to what is desired.

The development stage is the process of developing a product. This process is carried out to make the product a reality. Development that realizes the product will be validated to test the feasibility of the learning media. The product will be validated by an expert and tested on the target subjects of the development. Trials can be carried out to ensure no significant obstacles when the media is implemented.

The implementation stage is applying the subject to be given learning media treatment. After implementation, the subject is asked to respond to the media that has been used.

The evaluation stage aims to evaluate the interactive media products that have been developed. Material and media experts carry out validation tests to determine the feasibility of the product and whether the interactive media developed has overcome learning problems. Questionnaires are given to students to determine student involvement in the process and the appeal of the product developed.

The study subjects were grade IV students of Sekolah Dasar Taruna Dra. Zulaeha. All populations were taken into account when selecting a sample. The population and sample were 29 students. Learning was carried out over five meetings.

In this study, four alternative answers were used to facilitate data acquisition. The average value calculation was used to analyze the expert validation and design trial results. Decision-making is presented as an average percentage of each aspect. The scale consists of 4 levels, namely Very Good (82%-100%), Good (63%-81%), Less Good (44%-62%), Not Good (25%-43%), as modified in the study Riza *et al*. (2020). All quantitative data obtained are presented descriptively in the results and discussion sections.

RESULTS AND DISCUSSION

The development of interactive video is driven by the need for media for engaging learning that motivates students to understand mathematical concepts. The final product of the development is an interactive video that can be accessed using a browser. The video display can be set to a maximum resolution of 1080P. The interactive video developed contains mathematics subject content for measurement elements. The content in each video contains learning objectives. In the material section, instructions are given to support interactivity through pop-ups. There is a branching feature for students to choose a different storyline. Like conventional videos, interactive videos also describe material that can be accessed repeatedly according to student needs. A multiple-choice quiz is given at the end of the video to assess student understanding after studying the material. All interactions are recorded and shown after the video has finished running.

The design stage is created by creating content, flowcharts, and video display designs. The content is designed to facilitate the acceptance of the material by conveying the concept. The content is explained using delivery stages that make it easier for elementary school students. The flowchart is explained by providing a precise flow of instructions. As an instructional video, the display design uses cartoon characters to increase the learning motivation of elementary school students. Japanese cartoon characters, often called VTubers, are trending among children. Characteristics such as bright colors,

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simple shapes, and cute facial expressions are the main factors that make something visually attractive to children. Character design enhances and provides the audience with a new, more interesting communication experience with the instructor as conveyed by Putri in her final assignment research entitled "*Perancangan Karakter Animasi Vtuber Ikankumisan untuk Meningkatkan Audiens Live Stream*". The interactive video development flowchart can be seen in **Figure 2** as follows..

Figure 2. Flowchart Interactive Video
Source: Research 2024

Interactive video was made in the development stage. The hardware used was a laptop and a cellphone with a 1080P resolution recorder. The software uses Procreate, Canva, Reality, VN video editing, YouTube, and H5P.com. Interactivity features such as buttons, pop-up info, branching, data collection, and quizzes were provided to increase user endurance and allow them to continue interacting with the media being developed. **Figure 3** shows an example of the display when interactive video media displays learning objectives and avatars' appearance.

Figure 3. Learning Objectives View
Source: Research 2024

Next is the display of the material explanation, which can be seen in **Figure 4**.

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Figure 4. Material Explanation View
Source: Research 2024

Figure 5 shows the display of interactivity developed in the media.

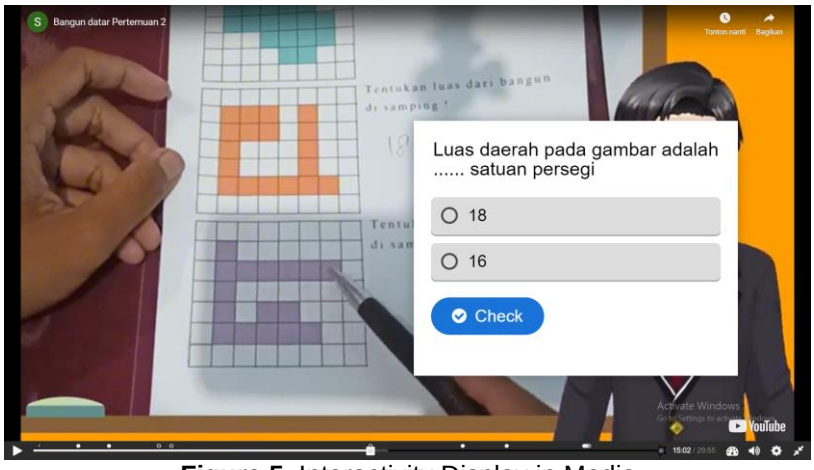

Figure 5. Interactivity Display in Media
Source: Research 2024

Students are directed to choose their interests. **Figure 6** shows a branching display that illustrates this.

Figure 6. Branching View
Source: Research 2024

Next, you can see the display for the quiz in **Figure 7**.

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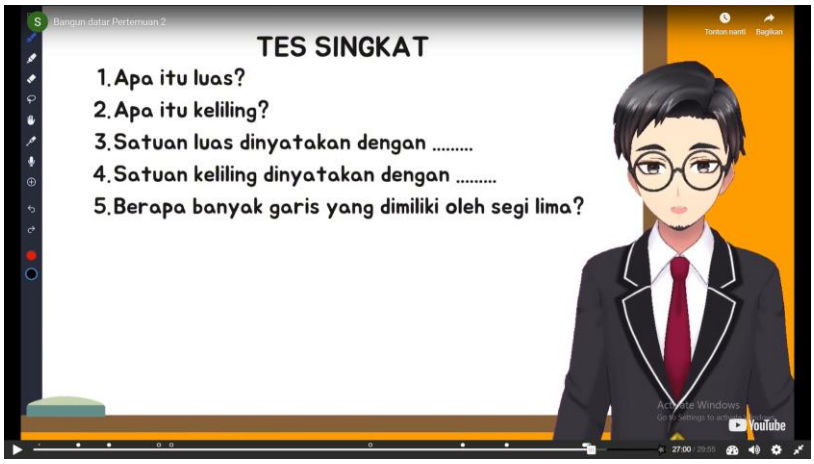

Figure 7. Quiz View
Source: Research 2024

To see the results, students can see their progress in answering the quiz through **Figure 8**..

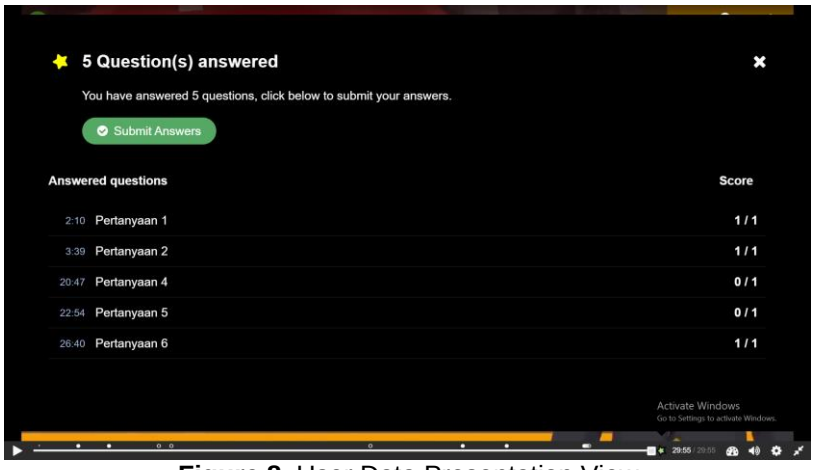

Figure 8. User Data Presentation View
Source: Research 2024

Validation

The development stage cannot be separated from product validation. Three expert validators test the developed media's feasibility: content experts, media experts, and design experts. The expertise of each expert determines the aspects assessed. The product validation results are shown in Tables 1, 2, and 3. **Table 1** shows that the average validation result of content experts is 90%, which means very good in terms of material suitability, content suitability, and language use.

Table 1. Content Expert Validation Results

Validator	Rated aspects	Percentage Results	Criteria
Content Expert	Material Suitability	87%	Excellent
	Content Eligibility	85%	Excellent
	Use of Language	100%	Excellent
	Average	**90%**	**Excellent**

Source: Research 2024

Table 2 shows that the average media validation result is 97%, which means it is excellent in ease, attractiveness, and motivation.

Table 2. Media Expert Validation Results

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Validator	Rated Aspects	Percentage Results	Criteria
Media Expert	Convenience	100%	Excellent
	Attraction	93%	Excellent
	Motivation	100%	Excellent
	Average	**97%**	**Excellent**

Source: Research 2024

Table 3 shows that the average design validation result is 97%, which means it is excellent in function, visuals, and audio.

Table 3. Design Expert Validation Results

Validator	Rated Aspects	Hasil Persentase	Kriteria
Design Expert	Function	91%	Excellent
	Visual	87%	Excellent
	Audio	100%	Excellent
	Average	**92%**	**Excellent**

Source: Research 2024

The three experts' assessment results showed excellent criteria, meaning the developed product can be used and tested.

Individual and Group Trial Results

Interactive video was tested on elementary school students. The trial was conducted twice with different respondents: individual trials with two students and group trials with eight students as respondents. After being treated with Interactive video, students were asked to complete a respondent questionnaire. **Table 4** shows the average results of individual and group trials.

Table 4. Individual and Group Trial Results

Tests	Rated Aspects	Percentage Results	Kriteria
Individual	Convenience	100%	Excellent
	Attraction	95%	Excellent
	Motivation	96%	Excellent
	Average	**97%**	**Excellent**
Group	Convenience	99%	Excellent
	Attraction	95%	Excellent
	Motivation	98%	Excellent
	Average	**98%**	**Excellent**

Source: Research 2024

The results of the respondent questionnaire showed perfect criteria, meaning that the product developed can be tested in the actual class.

Student Responses to the Use of Interactive Video

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After experts have declared the interactive video feasible and individual and group trials have shown no problems, the actual class trial is carried out. The product was tested on 29 students who were asked to evaluate it. The trial was conducted to obtain feedback on the use of interactive video. Table 5 shows the average results, which are very good.

Table 5. Hasil Uji Coba Kelas

Validator	Rated Aspects	Percentage Results	Criteria
Class	Convenience	99%	Excellent
	Attraction	99%	Excellent
	Motivation	99%	Excellent
	Average	**99%**	**Excellent**

Sumber: Penelitian 2024

The class respondent questionnaire results showed perfect criteria, meaning that the product developed answered the problem.

Discussion

Based on the results obtained, media development in learning can increase students' learning motivation. Providing interactivity in videos can make students stay longer to watch and listen. This is in line with the statement that interactive videos' functional and cognitive interactivity capabilities support the effectiveness of learning (Palaigeorgiou & Papadopoulou, 2019). The application of interactive instructional videos positively influences learning achievement and motivation (Liao *et al*., 2019).

Of course, in the development process, product revisions exist to develop products according to expectations. Validation is carried out alternately, and if declared feasible, the product being developed will be validated by the next expert. First, content validation is done twice; second, media validation has no revisions, and third, design expert validation is done once. After being declared feasible by the expert, the next step is the trial process.

The individual experiment was conducted with two students, while the group trial was conducted with eight students. The findings were obtained when using media with wired earphones, which interfered with students' interaction with the media. This finding was used as a new guideline to correct further implementation. Further implementation used speakers or wireless earphones. The implementation of the group trial had no significant obstacles, so it was better in the experiment.

Findings on learning Mathematics measurement elements. Students feel more motivated when learning is implemented using learning media. The change of conventional learning is certainly fun for students, regardless of the learning provided. Learning Mathematics measurement elements is more fun when given the concept of Mathematics rather than memorizing formulas or writing in notebooks. Students better understand the intent and purpose of learning Mathematics itself. Students admit that it is not like studying, but playing with videos.

Other findings regarding interactive features in the video include interactivity features such as buttons, pop-up info, branching, data collection, and quizzes. These features can make students stay longer while watching the video. Students find it difficult if they do not watch the video well, because they will face a quiz during or after the explanation. In line with research, Cresswell et al. (2019), students who use interactive video have more effective assessments and time in learning. Indirectly, the interactive feature can provide a good stimulus, making students listen to the video well.

The advantage of interactive video over conventional video is that it offers an increased conceptual understanding and achievement of desired learning outcomes through cognitive load management. It is

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closely linked to increasing learner engagement through active learning (Desai & Kulkarni, 2022). So, student involvement in the video can improve the understanding of Mathematics concepts, ultimately motivating students to learn. After implementing it in the classroom, the response was that there were technical obstacles outside of development, such as some computers experiencing slow internet, the videos displayed became less precise, the mouse suddenly stopped working, and the room conditions were quite noisy. Even so, the interactivity provided a positive experience that motivated students.

CONCLUSION

The development of interactive video facilitates elementary school Mathematics learning of measurement elements. The development produced a positive response from expert validators. The responses obtained in the trial were in accordance with what was expected when implemented in real classes. Although research on interactive video in education, especially in Indonesia, is still limited, the interactive video in question combines conventional video with a computer program. Interactive video can be used as a medium for learning that motivates students. Interactivity features such as buttons, pop-up info, branching, data collection, and quizzes can provide an experience for students to be more involved. Even so, there were still findings and criticisms from students in the implementation process. However, by providing learning media, students admitted to being more motivated in learning. This can be seen from the media use results based on user responses. Based on the conclusions and findings presented, the development of this interactive video can be used as evaluation material for further research on the same topic.

AUTHOR'S NOTE

This article is the result of our research. We guarantee that no third party has any influence or control over the content of this article. All opinions and findings presented in this article are entirely the result of our research. No party or entity has any influence or control over this research's content, findings, or interpretation.

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