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Validity of Adobe After Effect Assisted Learning Media Based on Realistic Mathematics Education for Primary Schools in Medan

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ABSTRACT

Mathematics learning relies on a foundation of interconnected concepts, making mastery of fundamental concepts crucial for academic success. To address this need, this study aims to evaluate the validity of animated video-based learning media, developed using Adobe After Effects (AAE) and grounded in the principles of Realistic Mathematics Education (RME), for elementary school students in Medan. This research employed a Research and Development (R&D) approach, following the ADDIE model's phases of analysis, design, and development. Data were collected through observation, interviews, questionnaires, and documentation, involving two media experts and three material experts (teachers) from three schools. The validation process involved converting qualitative evaluations into quantitative data. The validation by material experts yielded positive results, with an average score of 3 out of 4 points, indicating a good level of validity. Similarly, the media expert validation also showed a favorable outcome, with a mean score of 3.20 out of a possible 4. The analysis indicates that the developed animated video learning media, supported by AAE and based on RME principles, meets the required standards for effective use in mathematics education. The positive feedback from both media and material experts supports its potential for enhancing student understanding of elementary mathematics. The animated video-based mathematics learning media, validated by experts, demonstrates good usability and effectiveness, making it suitable for application in elementary school mathematics education.

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1. INTRODUCTION

The skills required of 21st-century teachers include the ability to develop and adapt learning content in line with technological advancements. Teachers must be capable of presenting learning media in a modern, creative, and innovative way, utilizing technology to enhance student achievement and motivation (Syawaluddin & Andi Makkasau, 2019). In the era of globalization, the demand for high-quality human resources, particularly teachers, necessitates the integration of information technology, communication, and knowledge into learning as part of teaching innovation, such as the Technological

Pedagogical Content Knowledge (TPACK) framework (BNSP, 2010; Mutiani & Nugraha, 2019; Nurdiana, 2016). This is further supported by the Minister of National Education Regulation Number 16 of 2007, which outlines teacher competencies in utilizing ICT for self-development and communication. TPACK enhances the learning experience by making it more enjoyable, effective, and successful in achieving educational goals (Ariyana, 2018).

However, observations conducted in three elementary schools in Medan revealed that many students perceive mathematics as a challenging subject due to the abundance of formulas and calculations needed to solve problems. Students also find math to be monotonous, as it often focuses heavily on numbers. During classroom observations, some students were engaged with the teacher's explanations, while others were disinterested, showing signs of boredom such as staring out the window, yawning, or chatting with peers. This suggests a lack of enthusiasm for mathematics and highlights that student interest in the subject remains low.

To address this, teachers need to effectively use learning media to ensure that content is accessible and engaging for students (Syahputra & Novrianti, 2022). Learning media not only enhances teachers' competencies but also helps create an interactive classroom environment where students can actively participate. Effective learning activities, supported by appropriate media, are essential for helping students achieve their educational goals (Lundström & Lundström, 2021). Media serves as a vital bridge that facilitates the transfer of knowledge between teachers and students, ultimately aiding in the achievement of learning objectives.

The use of learning media in primary schools in Medan is often not tailored to the specific characteristics of students, leading to suboptimal comprehension of lesson material. Laila et al. (2016) highlighted that many teachers lack innovation in their teaching approaches, causing students to become bored and disengaged, which hinders their ability to absorb lesson content. To address this, experts have developed various innovative media. For example, Nanda et al. (2022) created Powtoon-assisted learning media, which was validated by material experts with a 92% approval rating and media experts with 82%. Teachers rated this media positively, with an 81% satisfaction score, based on field testing with students. Hidayatullah et al. (2023) further demonstrated that using the Canva application in fifth-grade classes at SD Negeri Sambirejo 02 Semarang led to increased student engagement, creativity, and confidence. Similarly, Safitri & Koeswanti (2021) found that Adobe Flash-based "KELAS BANGTAR" learning media for improving mathematics outcomes in Grade IV received a 67% validity score from material experts and a 93% score from media experts, deeming it suitable for classroom use. Febriana et al. (2022) assessed the feasibility of motion graphic-based learning media created with Adobe After Effects, which achieved a 94% approval rating from multimedia experts and 96% from mathematics experts, placing it in the "Very Good" category. Student feedback from beta testing also indicated a high satisfaction rate, with an average score of 89.38%. These results suggest that motion graphic media is effective in supporting mathematics learning for third-grade students at Palembang 40 Public Elementary School.

Adobe After Effects software (AAE) is used in the construction of mathematical materials. AAE is one piece of software that may be used to make learning material more interesting (Anwar & Anis, 2020). Motion graphic design is commonly per-formed using AAE (Maharani et al., 2017). AAE is capable of manipulating text, pictures, audio, and video. AAE can also be used in conjunction with other Adobe programs like as Photoshop, Illustrator, and Premiere Pro (Smith et al. (2012)). In grade 4 SD/M mathematics, the use of the AAE software as an animation medium for mathematics subjects will be developed on fractional material. When employing learning media during the learning process, the contribution of student learning has a considerable influence: 90.1% of learning media affects student learning outcomes (Mujiani, 2016). According to the findings of Chasanah et al. (2021), the quality of the development video for length measurement materials received a score of 5.0 with a good predicate from mathematicians, a score of 4.7 from learning media experts, and a score of 4.75 from linguists. With the correct predicate, the teacher's assessment received a score of 5.0. The results of the restricted video trials were 100%, indicating that on aver-age, pupils responded well to the material developed in the film.

According Shaufia & Ranti, (2020), the model, method, and teaching materials utilized by teachers in classroom learning have a significant impact on students' capacity to understand abstract concepts in mathematics. Based on the previous sentence, implementation of AAE was adopting the great model; Realistic Mathematics Education (RME). The RME is a learning strategy that can aid students in their teaching and learning processes. According to a study by Amir et al. (2021), RME is an approach to studying mathematics that places mathematical issues in students' daily lives, making it easier for students to receive content and provide direct experience with their own experiences. Based on above statement, this work According to Amir et al., (2021), the RME approach aided by animation media can improve mathematics learning outcomes. Basiran et al. (2021) discovered that students who used teaching aids with the RME technique had a greater knowledge of mathematics than students who used an explanatory strategy. Additionally, the learning approach with beginning mathematical skills (high, medium, and poor) explained that there was an interplay between There are variances in students' understanding capacities and abilities to comprehend mathematical topics using the RME model and teaching materials. According to Oknisih et al., 2021, RME covers the same fraction concept and requires visuals to demonstrate the content with examples that students are familiar with. It encourages mathematical reasoning inquiry, broadens the RME approach, and offers learning through real-world examples that students can see and experience, so keeping them physically and mentally engaged.

Despite the successful development of various interactive learning media, such as the work by Astriawati (2020) and Pratiwi & Rahmawati (2022), there remains a gap in the creation of video-based learning tools specifically tailored to the Realistic Mathematics Education (RME) approach for certain mathematical topics, particularly for circle and fraction material. While previous studies have shown high validation scores and effectiveness of media in enhancing learning outcomes—such as the 95% effectiveness of RME-based V-MAU media for multiplication (Pratiwi & Rahmawati, 2022)—there is limited research on the use of Adobe After Effects (AAE) for developing video-based learning media in these mathematical areas. Moreover, the success of AAE in other subjects, as demonstrated by Reinita & Fitria (2022), highlights the need to explore its application in mathematics, specifically for primary school students.

The novelty of this research lies in addressing this gap by developing AAE-based video learning media tailored to the RME approach for teaching fractions and circles to primary school students in Medan. The study aims to assess the validity and feasibility of this media, contributing to the growing body of research on effective, technology-driven learning tools. This research aims to explore the validity, practicality, and effectiveness of AAE-based video learning media for teaching circle and fraction material in primary school. Specifically, it investigates how well the media is validated by media and material experts, and how practical and effective it is in enhancing students' understanding of these mathematical concepts.

2. METHODS

This research uses a Research and Development (R&D) model with the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) method. The first stage of this research is analysis. This stage is a preliminary stage consisting of 3 steps: curriculum analysis, learning media analysis and analysis of student characteristics. Second is the design stage. The design stage is where the media framework to be developed is designed. The design of this product must be distinct from the results of the first stage analysis. In this stage, a competency map and material map are prepared. Third is the development stage. AAE-based media production is carried out in the development stage using the RME approach. Apart from that, learning media is validated by media experts and material experts to be used in the learning process. Fourth is the implementation stage. This research is only discussed until the development stage. The research was conducted at three schools in the city of Medan, namely SDN 060842 Medan, SDN 064979 Medan, and SDN 064988 Medan. The research population was

elementary school students in Medan, while the research sample was 75 grade IV students. This research was conducted in the Even Semester of the 2023/2024 academic year.

The analysis stage is concerned with the need for validation instruments. At the analysis stage, the researcher gave an interview questionnaire to validators who were media experts in the Mathematics Education Study Program. The results of this questionnaire show that the Mathematics Education Study Program still needs to have a valid and standard validation instrument. The researchers themselves make the validation instruments that researchers usually use to validate media with their colleagues' help, so several types of validation instruments are used.

A validation sheet is a sheet used to evaluate products that are being developed. In the context of this research, the validation sheet contains a series of statements designed to assess the quality of a media in the development process (Syaitika & Fauziah (2023)). The development of a research instrument in the form of a validation sheet aims to provide a tool to measure the validity of a product resulting from the development that has been made. Preparation of research instruments is always carried out in a study because instruments are needed to collect the required research data (Adib (2017)). The use of validation sheets in the validation process aims to test the feasibility and reliability of the product that has been developed. Validation can be carried out through two approaches, namely involving experts and field tests. Various aspects of the instrument, such as negative formulation, clarity, balance, length, overlap in responses, use of technical language, use of specific terms, appropriateness of the listed responses, applicability to practice, and their relevance to problem criteria, can be analyzed in this process (Ediyanto et al., 2022).

The data collection technique uses four methods, namely observation by looking at and observing the actual situation, questionnaire/questionnaire method in the form of a statement to determine the extent of students' interest using AAE media, interviews to obtain information about the learning process using AAE media and documentation in the form of photos when research implementation events. Furthermore, the triangulation method is used to obtain credibility of the data in this research, namely comparing data obtained using observation methods, questionnaires, interviews, and documentation on research subjects.

1. Observing, often known as observing, is the process of paying attention to an item with all of your senses. As a result, observation is a data collection strategy that employs all five senses and requires meticulously documenting the object of study.
2. Questionnaire/Questionnaire. A survey is a data collection method that asks many questions about a research problem. According to Sugiyono's research (2017), a questionnaire is a data collection method that is carried out by asking respondents to provide several questions or written responses.
3. Interview. In the opinion of Sugiyono (2017), an interview is a meeting between two people who exchange information and ideas through questions and answers so that meaning can be constructed about a particular topic. Interviews are used as a data collection technique not only when researchers want to conduct preliminary research to clarify the problem being studied, but also when they want to know more about the respondents.
4. Documentation. Documentation is data gathered directly from researchers' talks. This is done to disclose the genuine picture in the field and collect primary sources on the relationship between school organizational culture and teacher job motivation. According to Sugiyono (2017), documentary research supplements the observation and interview methodologies employed in qualitative research.

This study employed a quantitative data analysis approach. The evaluation results from the validators were analyzed descriptively and qualitatively, serving as a basis for product revisions to ensure the development of a functional and usable product. The validators assessed the product design using a validation form, with the results evaluated through a Likert scale. The Likert scale is a tool used to measure attitudes by gauging the degree of agreement or disagreement with positive or negative statements regarding a particular object (Wagiran, 2013). Respondents were provided with five options for each item on the survey, with each indicator rated on a scale from 1 to 5: 5 (very good/very

appropriate/very accurate/very clear), 4 (good/appropriate/accurate/clear), 3 (fair/less appropriate/less accurate/less clear), 2 (poor/inappropriate/inaccurate/unclear), and 1 (very poor/very inappropriate/very inaccurate/very unclear).

3. FINDINGS AND DISCUSSION

3.1. Finding

In this RME-based AAE media development research, the R&D research method ADDIE model was used, going through the stages of analysis, preparation of design plans, development process, product testing, and evaluation processes carried out at each stage. In the initial stage, namely analysis, researchers conduct performance and needs analyses. For performance analysis, researchers conducted direct observations at three elementary schools in Medan to find out and classify the problems schools face during learning activities in the classroom related to learning media. During the observation, the researcher discovered an issue in students' misconceptions regarding the theory of the similarity of two fractions. Then, for the needs analysis, after finding a problem in class IV students, namely understanding the similarity of two fractions, the researcher provided a solution, namely a learning media that can be adapted to online and offline conditions regarding the similarity of two fractions in the form of a learning video. RME based, namely AAE. Students in learning mathematics need methods and media that apply mathematical principles but are still fun. This is also in line with what (Hikmah, 2017) stated: learning media are objects or methods used in learning to help teachers facilitate the delivery of material to students so that learning objectives or competencies can be achieved well. When choosing media, criteria analysis is also needed, namely that it must match the learning objectives or competencies that will be implemented. However, apart from this, you must pay attention to the characteristics and needs of students, as well as school conditions or facilities (Nurrita, 2018). Therefore, researchers are interested in solving this problem by developing RME-based learning videos, namely AAE. The choice of creating this learning media is because it can be adapted to conditions and is also based on the RME or RME approach with Iceberg theory, which has four levels of activity so that it can help teachers explain concepts and make it easier for students to understand them.

The second stage is design planning, which is carried out to make it easier for researchers to design AAE videos. The first thing to do is collect data and materials. This data or material collection includes images, animations, material on the similarities between two fractions, and several examples of similarities between two fractions in everyday life, which are illustrated using the RME approach to iceberg theory or icebergs. For data collection, this material was obtained from various sources. Meanwhile, the material and several examples come from student and teacher thematic books and previous learning videos, and attention is still paid to using the RME approach. Next is creating a learning media design. In making it, researchers used AAE software, which has various features and tools that support video creation. Next, prepare the storyboard media that will be developed. The first begins by arranging the contents of each slide from the media sequentially, including animations about the similarities between two fractions in the form of 2 examples using the RME approach. Then, after the videos are ready, they are recorded and voiced by the researcher briefly, concisely, and clearly so that students can easily understand them. The latter is exported or saved in .mp4 format.

The third stage is the product development process, which is carried out to realize the results of the product design that was prepared previously. This media development uses AAE software 2022 application. AAE software arranges designs into sections such as images, animations, backgrounds, and interactive text. After the slides have been placed, the researcher can do all the slides and sound by using the recording feature. Then, it is saved in video form or in .mp4 format. Using this software makes it easier for researchers to arrange the visuals and audio in the video so that they are synchronized and comfortable to watch.

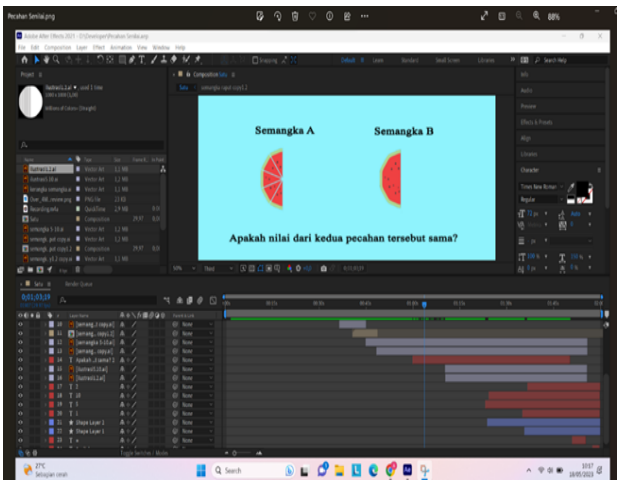

Figure. 1. Animated display of equivalent fractions with AAE

The results of this development are packaged as mp4 videos that can be played on all digital platforms, and the video is delivered to math teachers in Grade 4 SD/MI. In addition to information about the class 4 SD/MI fractions, the film was created as a learning animation with an introductory voice from a researcher. Two watermelons are shown in the mathematical notion of equal fractions. Figure 2 shows how watermelon A was cut into eight sections, whereas watermelon B was divided into two sections.

Figure. 2. Display of fractional results equivalent to Adobe After Effects

To demonstrate the notion of fractions in this painting, the student used four slices of watermelon A and one piece of watermelon B. Watermelon A had four out of eight pieces (4/8). In contrast, watermelon B had one component, making it 12. This video is depicted in Figure 3:

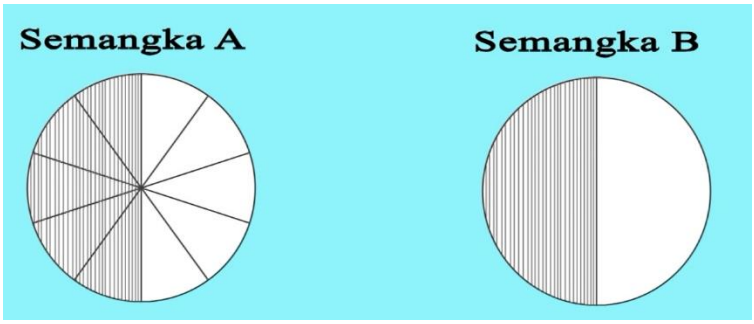

Figure. 3. Display of Adobe After Effects for the remaining part of the watermelon

Since the nature of the media allows it to be repeated constantly, the film's duration in this research was limited to 10 minutes to avoid repetition and student boredom. According to (Batubara & Ariani, 2016), the movie length should be between three and five minutes to avoid being excessively long (Yenti

(2020)). One of the advantages of videos is their versatility in size and environment. Furthermore, students absorb information more easily from videos than from printed teaching materials such as textbooks—the development of arithmetic products utilizing Adobe After Effects was evaluated and assessed using mathematical resources. The total time of the video in the present research did not exceed 10 minutes to prevent boredom and tedium for student since the character of the video allows it to be more minor, brief, and straightforward. According to (Batubara & Ariani, 2016), the video time should be between three and five minutes (Batubara & Ariani, 2016). One of the assets of a video is its adaptability in terms of its size and surroundings. Furthermore, pupils absorb information more easily from videos than printed teaching materials such as textbooks. Mathematical resources have evaluated and assessed the creation of mathematical materials using AAE.

In this research, the development stage is related to the animated video's validation, the animated video's revision, and limited testing.

1. Validate Animation Videos

Before testing, the government administration must evaluate animated video learning media to improve the learning media that has been prepared to make it more appropriate and effective. After being assessed by the gospel, the animated video is validated by media expert validators and material experts. This stage is carried out before conducting limited trials. Animated video learning media is considered valid by the validator if it falls within the very good or good criteria.

2. Revise the Animation Video

At the revision stage of this animated video, improvements were made by the researcher with the following criticisms and suggestions.

a. The duration of the video is too long, so you have to reduce the duration
b. In learning media, animated videos do not refer to problems
c. The animated video has no explanation of the material.

3. Limited Trial

This limited trial aims to determine how students respond to the learning media products being developed. Animated video learning media was tested on students at three elementary schools in Medan.

This study arrived at an assessment trial, which is the process stage used to determine (evaluate) whether the learning media being developed is successful and meets the initial development assumptions. All collected data were examined to decisive the level and usefulness of the media. The average score conversion is guided by the table below.

Table 1. Learning Media Rating Category

Average Score ($\bar{x}$)	Rating Category
$4{,}2 \leq \bar{x} < 5{,}0$	Very good
$3{,}4 \leq \bar{x} < 4{,}2$	Good
$2{,}6 \leq \bar{x} < 3{,}4$	Enough
$1{,}8 \leq \bar{x} < 3{,}4$	Less
$1{,}0 \leq \bar{x} < 1{,}8$	Very poor

Based on the data collected, the results of the material expert validation received an average score of 5.0, earning the designation "very good." The results of professional material validation and evaluation demonstrate that the video material complies with core skill regulations, fundamental abilities, and learning goals in the 4th grade SD/MI topic. Video content also includes materials that are based on realities, drafts, methodologies, and bases. According to (Amir et al., 2021), studying animated movies will be more entertaining if they are accompanied by content to be studied based on the

student's environment because they can boost memory and help students absorb material more quickly.

According to learning media experts, the instrument used in the media evaluation "Development of Grade 4 SD/MI Mathematics Material Through Adobe After Effects" contains six components, with details of the score obtained in the ensuing table:

Table 2. Score Results per category

Category	Score	Category Rating
Feature of students	4,0	Good
Appropriate	5,0	Very good
Security and Resilience	5,0	Very good
Appearance	4,5	Very good
Text	4,5	Very good
Audios	4,0	Good

Table 2 shows that, with the exception of student characteristics, all factors receive the label or category "very good." What is the "good" aspect of student characteristics? As a result, the total validation results from learning media professionals receive a grade of 4.5 with the title "very good." According to learning media specialists, the distinguishing feature of students is that they adhere to the characteristics of the primary school age; that is, they are not dull and may assist students in learning independently. Videos, on the other hand, will be more entertaining if the graphics on the material can move like people chatting. Learning films are thought to be extremely suitable, meaning that they are simple to use, simple to obtain, and inexpensive. Learning becomes more effective and efficient because it can be played at any time and from any location, and may increase or decrease. The time spent studying was not considered squandered. Learning videos are safe to use in terms of durability and security because the content utilized does not depart from learning principles, is not readily damaged even though it is afterward in the form of a CD, and can be used for a long time.

According to learning media specialists, video design is creative, simple, and modern (contemporary) and can pique students' learning interests. As typography is consistent, upright, and has conventional font sizes, images and words can be viewed and read effectively. In addition, the influence of asymmetrical and balanced video exhibit design can arouse students' interest. The rationale for this is that the background color does not interfere with the colors of the other components or with background color harmonization. The audio portion of the video was also considered. The implementation of music in learning activities is thought to benefit students by providing silence, supporting learners with understanding clearly, boosting innovation, and enhancing effectiveness of the right brain-left brain balance (Halimah, 2016). According to (Chasanah et al., 2021), music can influence students' cognitive development and emotional intelligence. Consequently, the researcher aided in the development of a video with instrumental music. The linguist's evaluation consisted of two parts: the aspect of language style and the element of authorship. Each aspect is given a different overall score, as shown in the table below:

Table 3. Score Results per Aspect of Language Expert

Aspect	Score	Category Rating
Language style	4,5	Very good
Essay	4,6	Very good

Table 3 displays the validation of linguists who scored 4.55/five in the "very good" category. In terms of linguistic style, the terminology employed was acceptable and accurately reflected the meaning to be expressed. However, Indonesian rule was not followed. These flaws serve as fodder for researchers to update grammar in movies and select sentences in which the language employed is

conventional, clear, straightforward, and communicative. Children quickly absorb the video messages. Authorship demonstrates that writing uppercase and lowercase letters employs enhanced spelling (EYD). Linguists in this study aim to determine the quality of the grammar utilized so that the text's meaning may be comprehended.

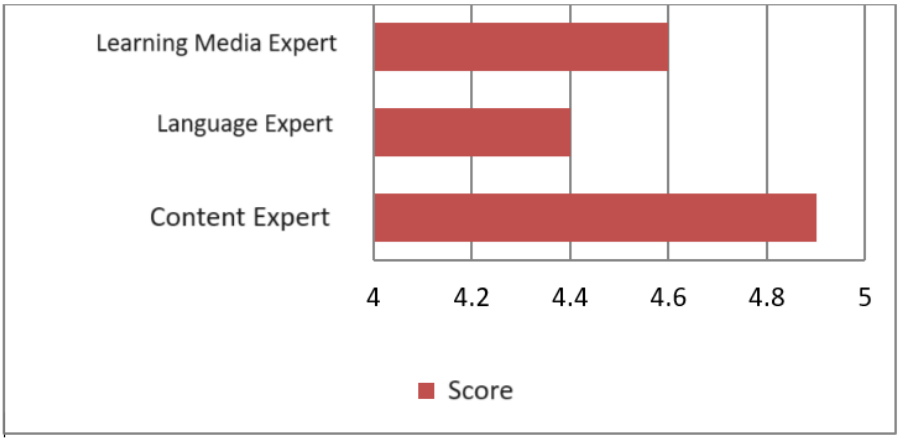

Figure 4. Graph of Validation Results

The evaluation of video material developed with AAE's software is able to be examined based on the outcomes of the teacher's assessment. The average score for the teacher's evaluation is $\bar{x} = 4.6$ with an impeccable predicate.

Table 4. Score Results per Aspect Class Teacher

Aspect	Score	Category Rating
Material Characteristics	5,0	Very good
Learner Characteristics	5,0	Very good
suitability	5,0	Very good
Security and Toughness	5,0	Very good
Appearance	5,0	Very good
Text	5,0	Very good
audios	5,0	Very good
Language style	5,0	Very good
Authorship	5,0	Very good

Table 4 indicates that the cultivation of instructional media can be implemented and verified on Grade 4 SD/MI students. The outcomes of media development were tested with students on a limited basis, and as many as 100% of students responded positively. Consequently, students receive growth videos that may be used in their studies, both online and offline. Films can influence students' concern and carry out fractional subjects easier to learn. According to (Raisa et al., 2017), students generally provided a satisfactory response rate of 81%. According to the media, students favorably influence their attractiveness, interest, and understanding of a topic (Raisa et al., 2017). This remark is also consistent with the findings of Pasko et al. (2016), who found that counseling with audiovisual approaches in video form increased children's knowledge by 60% (Pasko et al. (2016)). Furthermore, the use of video in learning is judged 48.14% more effective than not using video since utilizing the sensations of vision and listening when studying may aid students in learning material within the learning process. (Agustiningsih, 2015). As suggested by Dale's cove of expertise and Brunner's theory, learning will be more important if teachers can create an atmosphere for education that simultaneously engages the students' five senses within the learning process. As a result, students will have no trouble assimilating the material being studied (Hadi, 2017).

4. CONCLUSION

This study addressed the challenges students face in understanding abstract mathematical concepts by developing video-based learning content using Adobe After Effects (AAE). The product's validity and practicality were assessed by experts, including mathematics specialists, learning media professionals, and linguists, all of whom gave high ratings. The mathematics expert assigned a perfect score of 5.0, the learning media expert gave a 4.7, and the linguists rated it 4.75, all within the "very good" category. These validation results indicate that the video content is suitable for classroom use. Additionally, teacher evaluations awarded the video a perfect score of 5.0, while students responded positively with a 100% approval rate, suggesting that the videos effectively engage students and provide meaningful learning experiences. Despite these promising results, the study has limitations, as the product has not yet reached the dissemination phase or undergone extensive testing for effectiveness with a broader group of students. Future research should focus on scaling the dissemination and evaluating the video's impact on student learning outcomes to ensure its broader applicability across Indonesian schools. This research emphasizes the importance of teachers being innovative and creative in developing learning media to enhance student engagement and learning outcomes. Furthermore, schools are encouraged to support teachers by offering professional development opportunities, such as training or workshops on media development, to foster continuous improvement in instructional practices.

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