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Development of Interactive Media Based on Articulate Storyline with a Culture Responsive Teaching Approach in Spatial Volume Building Material at SD Negeri 01 Sengare, Talun District, Pekalongan Regency

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A B S T R A C T

This study aims to develop and assess the quality of interactive multimedia based on Articulate Storyline with a Culturally Responsive Teaching (CRT) approach in spatial volume material in elementary schools. The study used the Research and Development (RnD) method with the ADDIE model, which includes analysis, design, development, implementation, and evaluation. Validation was carried out by subject matter experts and media experts, while practicality and effectiveness were measured through teacher and student questionnaires and pre-tests and post-tests. The results showed that this media was highly valid, with a subject matter expert validation percentage of 92% and media validation of 94%. The practicality of the media was also high, with positive responses from 80% of students and 84% of teachers. The effectiveness test showed a significant increase in student learning outcomes, with an N-Gain value of 0.7143, which is in the high category. These findings confirm that Articulate Storyline-based interactive multimedia that integrates CRT is feasible, practical, and effective for improving mathematical concept understanding, student engagement, and learning outcomes for solid volume material in elementary schools.

1. Introduction

Elementary school is an important foundation for the success of students in higher levels of education (Rizal, 2021). Education itself is a basic right of citizens as affirmed in Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, which states that education is a conscious and planned effort to develop the full potential of students. However, in practice, there are still

various obstacles, particularly in mathematics learning at the elementary school level. Data from the Organisation for Economic Co-operation and Development (OECD) through the 2022 Programme for International Student Assessment (PISA) shows that Indonesia ranks 69th out of 81 countries in mathematics, lagging behind countries such as Singapore and Japan (BBC News Indonesia). This shows the need for learning innovation, including the use of effective media.

Learning media plays an important role in improving students' understanding, motivation, and learning outcomes (Hamid et al., 2020; Atiaturrahmaniah, 2017; Wahyuningtyas, 2020). In mathematics, conceptual understanding is very important for students to be able to think logically, analytically, and solve problems (Arina et al., 2020). However, elementary school students' ability to understand the concepts of solid volume—such as blocks, cones, and pyramids—is still low due to their abstract nature and weak mastery of prerequisite concepts (Mahsup et al., 2018; Kurino, 2017). As a result, students tend to only memorize formulas without fully understanding the concepts, especially when dealing with story problems. The learning process at SDN 01 Sengare and SDN 02 Kalirejo faces challenges due to the diversity of students' backgrounds, low technological literacy, and lack of interest in learning, which affect learning outcomes. Special Allocation Fund (DAK) assistance in the form of laptops from the Ministry of Education and Culture is expected to support 21st-century learning, but there are still obstacles such as a generation gap among teachers and monotonous learning methods.

The integration of interactive multimedia, such as Articulate Storyline with a Culturally Responsive Teaching (CRT) approach, is considered effective because it combines elements of local culture in learning, making it more contextual and interesting (Cahyaningsih, 2024). Previous research shows that interactive multimedia can increase students' interest and understanding of spatial volume concepts (Arina et al., 2020). Based on these issues, the development of Articulate Storyline-based interactive multimedia with a CRT approach is a strategic solution to improve understanding of the concept of solid volume while optimizing the use of Chromebooks in grades VI of SDN 01 Sengare and SDN 02 Kalirejo.

Development is a systematic effort to improve technical, theoretical, conceptual, and moral abilities through education and training (Fitri, 2025). In the context of learning, development aims to improve the quality of the learning process, both in terms of material and methods, to keep up with the development of science and the needs of students (Hamid, 2020). Development research itself is a scientific step to produce or refine accountable products, such as learning media based on Articulate Storyline with a Culturally Responsive Teaching approach to spatial construction material in elementary schools. Theoretically, this development is in line with Jerome S. Bruner's learning theory, which emphasizes the stages of mental development from concrete to pictorial to abstract, as well as the process of actively acquiring, transforming, and testing knowledge. This theory emphasizes the importance of problem solving and the development of students' intellectual abilities in mathematics learning (Awaludin et al., 2021).

Learning media is very important in mathematics because many concepts are abstract. Media serves as a means of conveying messages that help make the learning process more effective and efficient (Yunita, 2020; Nurmala, 2025). If designed well, media can represent the role of teachers in conveying information (Wahab et al., 2021). The selection of media must be tailored to the objectives, material, and characteristics of students in order to optimize learning (Fahmi, 2021). The use of media also increases student engagement, motivation, and critical thinking skills (Sirait et al., 2023).

Mathematics learning in elementary schools needs to be adapted to the concrete operational thinking stage of students and emphasize early conceptual understanding through media or teaching aids (Ruqoyyah, 2021). The characteristics of elementary school mathematics learning include a spiral and gradual approach from concrete to abstract (Panggabean et al., 2022). The goal is to develop the ability to understand concepts, reason, solve problems, communicate ideas, and foster a positive attitude toward mathematics as stated in the Minister of National Education Regulation Number 22 of 2006. In the context of the Merdeka Curriculum, mathematics learning emphasizes deep conceptual understanding, reasoning, problem solving, mathematical communication, and the formation of self-confidence and curiosity. The learning process is viewed as a mental activity to construct and reconstruct knowledge in order to develop students' thinking skills comprehensively.

Geometry is a branch of mathematics that studies plane and spatial shapes and their elements, such as points, lines, angles, as well as the measurement of circumference, area, and volume (Ahmad et al., 2020). In elementary school, geometry is an important foundation because students are required to understand the concepts and properties of plane and spatial shapes to develop logical and systematic thinking skills. Geometry learning in elementary school plays a role in developing students' logical, creative, and spatial thinking skills. Therefore, learning should begin with concrete objects in the surrounding environment and gradually move to abstract concepts for greater meaning and ease of understanding.

Interactive multimedia is an integrated combination of text, images, audio, video, and animation that allows users to interact directly with the content. This interactivity gives users the freedom to control the order and pace of material presentation (Daryanto, 2013). In education, interactive multimedia increases learning effectiveness by supporting independent learning, adapting to learning styles, and providing immediate feedback (Surjono, 2017). Thus, interactive multimedia creates a more dynamic, engaging, and student-centered learning experience. Interactive multimedia makes learning more engaging, improves concentration, saves time, and allows for flexible learning (Faiz, 2025). Its advantages include improving memory, accommodating various learning styles, motivating students, being interactive, and being suitable for both individual and group learning. Furthermore, the combination of various media elements can increase participation and simulate objects that are difficult to present in the classroom.

Articulate Storyline is authoring software for creating interactive learning media that integrates text, images, audio, video, animation, and quizzes (Nurkhalimah, 2025; Hastri, 2025). The output can be published in HTML5 format or as an application (.exe) so it can be accessed via laptops, tablets, and smartphones. Its interface is similar to Microsoft PowerPoint, making it easy for novice teachers to use (Arwanda et al., 2020). Its advantages include templates, triggers, layers, characters, automatic navigation, and integration with LMS without requiring programming skills (Yasin, 2017). According to Amiroh (2020), Articulate Storyline requires the following minimum specifications: a 2 GHz processor, 2 GB of RAM, 1 GB of storage space, a screen resolution of 1280 × 800, and a Windows 7 or later operating system or Mac OS with a virtual machine. The .NET Framework and Visual C++ Redistributable are also required. Installation is done by downloading the file from the official website, running as an administrator, agreeing to the license, and then clicking install. Key features include New Project, Record Screen, Import, Triggers, Timeline, and Publish (HTML5 or Flash). These features facilitate the creation and distribution of interactive learning media.

Articulate Storyline's advantages include: ease of use, interactive, support for various media formats, the ability to create quizzes without additional applications, and the ability to publish web-based or through an LMS (Nabila, 2023). This media is also communicative and flexible, increasing student understanding and engagement (Rohmah et al., 2020). Disadvantages include a 30-day free trial period, the need for supporting software when running in certain HTML formats, limited display resolution, and challenges with excessive slides when publishing web-based (Fatia, 2020).

Culturally Responsive Teaching (CRT) is a pedagogical approach that utilizes students' cultural backgrounds, experiences, and perspectives as the basis for learning. According to Gay (2018), CRT uses students' cultures as a framework for effective teaching and creating an inclusive learning environment. Ladson-Billings (2021) emphasized that CRT integrates students' cultures into the curriculum and learning practices, while Nieto (2020) emphasized the importance of critical awareness of social issues and injustice. In a multicultural context like Indonesia, CRT is relevant for reducing educational disparities and increasing student participation. Its implementation requires teachers to be multiculturally aware so they can reflect on bias and build a safe and student-friendly learning environment (Aceves, 2014). The steps for implementing CRT (Gay, 2018) include: (1) recognizing students' cultural identities, (2) constructing cultural understanding, (3) collaboration, (4) critical reflection, and (5) transformative construction through projects.

The principles of CRT emphasize: recognizing and integrating local culture into learning; the relevance of material to students' cultural contexts (Rahmawati, 2025); empathetic teacher-student relationships; empowering students' cultural identities; flexible strategies tailored to learning styles; collaboration with families/communities; and critical teacher reflection on cultural bias (Prastowo, 2023). In developing interactive multimedia based on Articulate Storyline, CRT can be integrated by incorporating local values and wisdom into the content,

language, images, and narrative. For example, in the material on the volume of geometric shapes, examples are taken from local cultural objects to enhance context. With culturally responsive design, multimedia not only enhances conceptual understanding but also strengthens inclusivity and respect for diversity (Gay, 2018). One of the biggest challenges for teachers is utilizing engaging learning media to create an active and enjoyable learning environment. Teachers, as facilitators, are required to optimally engage students, but this is not easy. At SD Negeri 01 Sengare, mathematics lessons still use videos and PowerPoint presentations separated from the material and worksheets. This results in a lack of interactivity and an inability to fully visualize concepts, particularly in the material on the volume of three-dimensional geometric shapes. This situation highlights the need for the development of more integrated, engaging, and interactive media.

Based on the problem formulation that has been put forward, this study aims to develop and assess the quality of interactive multimedia based on Articulate Storyline with a Culturally Responsive Teaching (CRT) approach on the material of volume of solid shapes in elementary schools. Specifically, this study is directed to determine the level of feasibility of the developed product, test its practicality in the learning process, and analyze its effectiveness in improving students' understanding and learning outcomes.

2. Methodology

The approach used in this research is research and development (RnD). This method was chosen because it allows researchers not only to develop a product but also to systematically test its validity and effectiveness. According to Sanjaya (2013), RnD is a process used to develop a product while assessing its validity through validation. Similarly, Sugiyono (2010) explains that this method includes research steps aimed at creating a specific product and testing its effectiveness after it is produced. Thus, the R&D method provides a systematic framework for creating a product and assessing its benefits and effectiveness in achieving the desired learning objectives. According to Sugiyono, the steps in R&D are as follows:

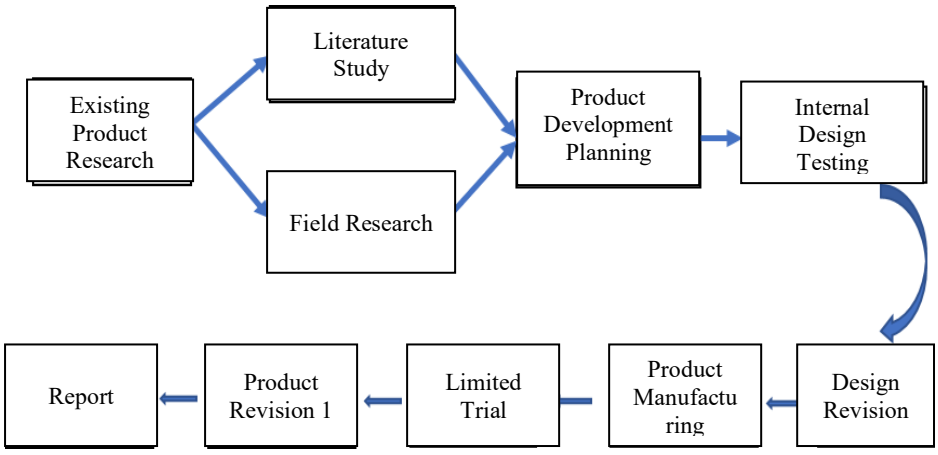

Figure 1. Steps for developing interactive media based on Articulate storyline

This research was conducted at two locations: SD Negeri 01 Sengare and SD Negeri 01 Kalirejo. Both schools were the first recipients of Chromebooks from the government in Talun District in 2023, thus having adequate technological facilities to support interactive multimedia-based research. The research was conducted from the even semester of the 2024/2025 academic year to the odd semester of the 2025/2026 academic year. The research period was designed in stages to encompass product development, practicality testing, and effectiveness testing of the Culturally Responsive Teaching (CRT)-based Articulate Storyline learning media for volume of geometric shapes in elementary schools.

This Research and Development (R&D) design used the ADDIE development design. The ADDIE model is simple yet effective and systematic in its implementation. ADDIE stands for five stages: Analysis, Design, Development, Implementation, and Evaluation (Ciung et al., 2022). Data collection techniques in this study included expert validation, questionnaires, and tests. Expert validation aims to obtain input from reviewers to improve the product development, which includes aspects of language, content, presentation, and graphics (Thiagarajan, 1974). Practicality testing was conducted through questionnaires to teachers and students and observations of product use in learning. Effectiveness testing was conducted through tests on students using a quasi-experimental design Nonequivalent Control Group Design with pretest, treatment, and posttest to measure improvements in learning outcomes (Sanjaya, 2013; Sugiyono, 2010). Data analysis techniques in this study were carried out to assess the feasibility, practicality, and effectiveness of Articulate Storyline (AS) with a Culturally Responsive Teaching (CRT) approach.

a. Feasibility Analysis

The feasibility data was obtained from the expert validation sheet using a 4-point Likert scale: 4 = very good/strongly agree, 3 = good/agree, 2 = not good/disagree, 1 = very not good/strongly disagree (Sugiyono, 2010). The validity score was calculated using the formula:

$$V = \frac{K}{MK} \times 100\%$$

where V = percentage of validity, K = validator assessment score, MK = maximum score. Media validity criteria are categorized as very valid (≥75%), valid (50–75%), less valid (25–50%), and invalid (<25%).

b. Practicality Analysis

Practicality data was obtained from a student response questionnaire using a 4-point Likert scale. The percentage of student responses was calculated using the formula:

$$RS = \frac{F}{N} \times 100\%$$

where RS = percentage of response, F = score of each indicator, N = maximum score (Trianto, 2010). The practicality category is classified as very practical (≥75%), practical (50–75%), less practical (25–50%), and impractical (<25%) (Widoyoko, 2012).

c. Effectiveness Analysis

1. Validity of Pretest and Posttest Items: The items were analyzed using Aiken's V validity coefficient to ensure their validity.
2. Analysis of Pretest and Posttest Results: Student scores were converted into grades using the following formula:

$$\text{Value} = \frac{\text{Score obtained}}{\text{Maximum score}} \times 100$$

The pretest and posttest result categories are divided into: very good (80–100), good (66–79), sufficient (56–65), less (40–55), fail (30–39). Product effectiveness is measured using N-Gain:

$$g = \frac{\text{Posttest} - \text{Pretest}}{\text{Maximum Score} - \text{Pretest}}$$

N-Gain categories: high (≥0.7), medium (0.3–0.7), low (0–0.3). Overall, this analysis allows researchers to assess the extent to which CRT-based AS is feasible, practical to implement, and effective in improving student learning outcomes.

3. Results and Discussion

This research used a Research and Development (R&D) method to produce an innovative product, an AR Math Book, intended for learning volume of solid shapes at the elementary school level. Product development followed the ADDIE model, which consists of five main phases: Analysis, Design, Development, Implementation, and Evaluation (Maydiantoro, 2021). The ADDIE model was chosen because it is structured, systematic, easy to implement, and has proven effective in developing learning media. Therefore, this model serves as a guide in creating an AR Math Book based on Augmented Reality that meets student needs.

Feasibility Results of Articulate Storyline Interactive Media with the CRT Approach

The development of Articulate Storyline (AS) based on Culturally Responsive Teaching (CRT) aims to create a fun learning experience and improve student learning performance through engaging materials.

a) Analysis

The analysis phase was conducted to ensure the interactive media developed met needs. The analysis included:

1. Content Analysis
   The researcher reviewed the Learning Objectives Flow (ATP) and the Grade VI Mathematics subject documents to determine the Learning Objectives (TP) and Learning Outcomes (CP) that students must achieve. This content analysis served as the basis for selecting the core competencies and materials to be presented through the interactive media.
2. User Analysis
   This analysis assessed student characteristics, learning needs, and their ability to use technology-based media, ensuring optimal understanding of the material presented.
3. Hardware Requirements Analysis
   The researcher evaluated the readiness of the devices used, including computers, Chromebooks, or tablets, to ensure the media would run smoothly in the learning environment.

The results of these three analyses served as the basis for the design and development stages of Articulate Storyline-based interactive media using the CRT approach, ensuring that the media was not only pedagogically effective but also culturally relevant for students.

Table 1. Learning Objectives and Learning Outcomes

Learning objectives	Learning Outcomes
Explains geometric shapes which are a combination of several geometric shapes and their surface area and volume.	- Students can identify various simple geometric shapes (cubes, cuboids, prisms, pyramids, cones, cylinders, and spheres) and their properties. - Students can cite examples of everyday objects that are compound geometric shapes. - Students can explain strategies or steps for calculating the surface area and volume of compound geometric shapes.
Explains what is a combination of several geometric shapes and the properties of geometric shapes.	- Students can identify various simple geometric shapes (cubes, cuboids, cylinders, cones, spheres, prisms, pyramids) in their environment. - Students can list the characteristics of geometric shapes based on their elements (sides, edges, vertices). - Students can differentiate geometric shapes based on their shapes and geometric properties.

Based on the syllabus analysis, the first Learning Objective (TP) was established, namely explaining geometric shapes that are combinations of several geometric shapes and calculating their surface areas and volumes. The second TP was identifying composite geometric shapes and their surface areas and volumes from a local cultural perspective. The selection of TPs and Learning Outcomes (CPs) was tailored to the needs of learning media in schools, particularly for geometric shapes. These needs included the provision of interactive media that enable students to learn from the material, properties, formulas, and relevant practice exercises. This enabled the developed media to provide more concrete and meaningful visualizations and learning experiences.

User analysis was conducted through observations at SD Negeri 01 Sengare, which revealed that most students experienced difficulties in understanding the geometric shapes material. Furthermore, the use of Chromebooks received through government DAK assistance was not optimally utilized in learning. These findings serve as important considerations for researchers in developing interactive-based learning media to maximize the use of available devices and increase student engagement and understanding of the geometric shapes material.

b) Design

The design phase plays a crucial role in this research because media design significantly influences the effectiveness of learning delivery to students. Prior to media development, researchers conducted a literature review to gather data on appropriate and effective Articulate Storyline-based interactive media designs, particularly for the volume of geometric shapes. In this design phase, researchers not only designed the learning media but also developed a learning plan that would be implemented when using the interactive media.

The design phase began with the creation of a Media Program Outline (GBPM). The GBPM was structured based on the core competencies established in the analysis phase, then broken down into topics and subtopics that the media must address. Next, researchers determined the presentation format and reference sources, ensuring that the interactive media developed had a clear, systematic, and easily understood structure for students. Furthermore, this design also included 2D visual design, interactivity, and media navigation flow that support enjoyable and contextual learning.

c) Validation by Experts

The validation phase is a crucial step in developing learning media to ensure product quality, both in terms of content and presentation. Validation was conducted by experts consisting of material experts and media experts through expert review, the results of which were then used as a basis for improvements before user trials.

Material Expert Validation

Material validation was conducted by an expert in education, Dr. Bagus Andi Saputra, M.Pd., Lecturer in the Master of Elementary Education program. The purpose of this validation was to obtain expert feedback and suggestions regarding the quality of Articulate Storyline-Based Interactive Multimedia learning media, particularly in terms of content and material. Input provided by the material experts included the suitability of the content to core competencies, the accuracy of the information, the relevance of sample questions, and the relevance of the material to the local cultural context. The results of this assessment served as the basis for researchers to make revisions so that the product could be more appropriate, valid, and effective for use in classroom learning.

Table 2. Material Expert Assessment

Assessment Aspects	Number of Grains	Maximum Score	Total Score Obtained	Presentation
a. Suitability and Completeness of Material	4	20	16	18
b. Accuracy and Correctness of Concepts	4	20	18	18
c. Integration of CRT Approach	4	20	18	18
d. Context and Application	3	15	15	15
e. Overall Content Suitability	4	20	18	18
Total	19	**95**	85	87

Total Score Obtained: _____85__ out of 95
Percentage of Feasibility: (Total Score / 95) × 100% = ____89.47____%
Feasibility Category Based on Percentage:
90% - 100% (85.5 - 95 points): Very Feasible (Can be used without revision)
75% - 89% (71.25 - 84.75 points): Feasible (Can be used with minor revision)
65% - 74% (61.75 - 70.3 points): Fairly Feasible (Requires substantial revision)
65% (<61.75 points): Less Feasible (Requires redesign)

Quality of content/material according to material experts with indicators including completeness of material, breadth of material, accuracy of concepts and definitions, accuracy of data and facts, accuracy of images and illustrations, accuracy of terms, number of cases in everyday life, and encouragement of curiosity know, and create the ability to ask questions. The percentage of the assessment obtained was 89..47% which means it obtained the category "Very appropriate". The quality of presentation according to the material expert obtained a percentage of 91.57% which means it is in the category "Very Good". The assessment is based on indicators which include the consistency of the presentation system in learning activities, conceptual sequence, student involvement, the relationship between learning activities, and the integrity of meaning in learning activities. With the calculation of the Total Score Obtained: 87 out of 95, the Percentage of Appropriateness: (Total Score / 95) × 100% = 91.57%. The improvements provided by the material expert are as follows:

Media Expert Assessment

Next, an expert review was conducted by a media expert, Dr. Joko Sulianto, S.Pd, M.Pd., a lecturer in the Master of Elementary Education program. The goal was to obtain feedback in the form of assessments and suggestions from experts regarding Articulate Storyline-based interactive multimedia learning media, particularly in

terms of media design, to produce a high-quality, usable product. The following table summarizes the expert review results from the media experts:

Figure 2. Additional questions on geometric shapes

Table 3. Media Expert Assessment

Assessment Aspects	Number of Grains	Maximum Score	Total Score Obtained	Presentation
a. Visual Design and Layout	5	25	21	21
b. Function and Interactivity	5	25	23	23
c. Audio and Multimedia	3	15	10	12
d. Ease of Use (Usability)	3	15	15	15
e. Technical and Compatibility	3	25	15	15
Total	19	**95**	84	86

Total Score Obtained: ___84_____ out of 95
Percentage of Feasibility: (Total Score / 95) x 100% = ____89.37____%
Feasibility Category Based on Percentage:
90% - 100% (85.5 - 95 points): Very Feasible (Can be used without revision). 75% - 89% (71.25 - 84.75 points): Feasible (Can be used with minor revisions as suggested). 65% - 74% (61.75 - 70.3 points): Fairly Feasible (Requires substantial revision before use). <65% (<61.75 points): Less Feasible (Requires redesign of most aspects). Media assessment based on indicators to assess the articulate storyline. This assessment aims to assess the visual aspects, interface design, and user experience of the learning media.

Table 4. Expert Assessment

No.	Reviewer	Content/Material (%)	Presentation (%)		Average (%)	Assessment Category
1.	Subject Matter Expert	94,38	90,5		95,83	Very good
No.	**Reviewer**	**System (%)**	**Appearance (%)**	**Appearance AR**	**Average (%)**	**Assessment Category**
1.	Media Expert	100		100	91,67	Very good
		Average			93,38	Very good

Media experts and material experts determined that the media was suitable for use in learning activities. Overall, the articulate storyline media received a very good rating from the experts. However, improvements are still needed before the media can be used by users. The following are the details of the improvements. The material experts suggested adding explanations about the volume of geometric shapes related to everyday problems. The volume of geometric shapes does require learning media to facilitate students' understanding of the abstract learning material. It is hoped that students will be able to apply the concept of volume in everyday life.

Practicality Results of Articulate Storyline-Based Interactive Multimedia for Volume of Geometric Shapes in Elementary Schools

The implementation phase of this research involved two user categories: teachers and students, to obtain feedback on the practicality of Articulate Storyline-Based Interactive Multimedia (AS) using the CRT approach. Respondents consisted of one sixth-grade teacher and 21 sixth-grade students at SDN 01 Sengare. Data collection was conducted through a questionnaire containing assessment indicators related to content/material, media suitability, the CRT approach, pedagogical aspects, ease of use, and the media's benefits and relevance.

a. Teacher Responses

Questionnaire results showed that teachers rated the AS media with the CRT approach as very good quality, with a practicality percentage of 90%, including aspects of content/material, media suitability, and pedagogy. This assessment indicates that the media is suitable for use and effectively supports learning. Teachers' suggestions for improvement, such as adding text to the formula and simulation menus to avoid images, have been implemented by adding names to each geometric figure, thus increasing the visual clarity of the media.

Before After

Figure 3. Improvements to the naming of geometric figures for the Articulate storyline.

b. Student Responses
After using the media, students were asked to assess the practicality of the CRT-based interactive multimedia. The questionnaire results showed an overall percentage of 92.8%, including aspects of visual and design, ease of use, learning materials, integration of local culture (CRT), and benefits and learning interest. The visual aspects and integration of local culture were the main attractions for students, indicating that this media is highly suitable and effective for use in learning spatial geometry. Based on teacher and student assessments, Articulate Storyline-Based Interactive Multimedia with the CRT approach has a high level of practicality, effectiveness, and is suitable for use in learning the volume of spatial geometry in elementary schools. Several suggestions for improvement have been implemented to enhance the quality of the media so that it can be used more widely in other learning materials.

Effectiveness of Articulate Storyline-Based Interactive Multimedia for Volume of Spatial Geometry in Elementary Schools

The evaluation phase was conducted by assessing the effectiveness of the media through pretests and posttests given to sixth-grade students. The pretest and posttest items were assessed by subject matter experts and sixth-grade teachers based on the material, construction, and language aspects. Validity analysis using Aiken's V showed an average validity coefficient of 0.93, which falls into the "Valid" category (Prihono, 2019). All test items with an Aiken's V value > 0.60 were deemed suitable for use in the trial.

Before and after using the media, students completed 10 essay questions for 90 minutes. Pretest results showed that most students scored below the Minimum Competency (KKM = 65), with only a few students (A8, A12, A16, A19, and A21) achieving scores above the KKM. After learning using Articulate Storyline-Based Interactive Multimedia with the CRT approach, posttest results showed significant improvement. The highest posttest score was 100 for student A11, while students A16 and A19 each scored 95. These results indicate an increase in students' understanding of the volume of geometric shapes after using the media, indicating its effectiveness in improving learning outcomes. The increase in pretest and posttest scores demonstrates that the use of Articulate Storyline-based interactive media, which integrates the CRT approach, can increase engagement, interest, and a deeper understanding of mathematical concepts.

Discussion

Feasibility Results of Articulate Storyline-Based Interactive Multimedia for Volume of Solid Figures

Validation results from material experts and media experts indicate that Articulate Storyline-based interactive media is suitable for use in learning activities. The experts assessed this media as excellent in terms of content, design, and integration of the Culturally Responsive Teaching (CRT) approach. The material experts emphasized the importance of the media's suitability for abstract learning materials

such as volume of solid figures, while the media experts recommended expanding the content batch for broader coverage. These findings align with research by Rizal (2021), which showed validation from material experts at 88.42% and media experts at 87.5%, categorizing it as "Very Suitable for Use." Therefore, this media is considered valid for implementation in elementary school learning.

Practicality Results of Articulate Storyline-Based Interactive Multimedia

Participants in this study included one teacher and 21 sixth-grade students. User assessments indicated that the media met the Very Good criteria, both from the teacher and student perspectives. Suggestions for improvement primarily concerned expanding the material coverage, which could not be implemented due to time constraints and the lack of supporting equipment. The use of Augmented Reality (AR) technology provides a unique learning experience, increasing student engagement, motivation, and understanding (Garrett, 2018). Research by Setyawan (2019) also supports these findings, stating that AR learning media received a positive response from students and is suitable for use as a learning support medium.

Effectiveness Results of Articulate Storyline-Based Interactive Multimedia

a. Normality Test

Pretest and posttest data were analyzed using normality tests (Kolmogorov-Smirnov and Shapiro-Wilk).

Table 5. Normality Test Results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Pretest	.105	21	.200*	.973	21	.788
Posttest	.145	21	.200*	.935	21	.170

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The results showed a significance value of 0.820 > 0.05, indicating that the posttest data were normally distributed, allowing for parametric statistical analysis.

b. Testing the Difference in Pretest and Posttest Means

The T-test used the Paired Sample t-Test formula to measure the data obtained from the pretest and posttest. The following are the results of the T-test calculation using SPSS 24:

Table 6. Paired Sample T-Test Results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	54.6190	21	10.45694	2.28189
	Posttest	85.6667	21	9.94150	2.16941

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pretest & Posttest	21	.969	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest - Posttest	-31.04762	2.59762	.56685	-32.23004	-29.86520	-54.773	20	.000

The Paired Sample t-test showed a pretest average of 54.62 and a posttest average of 85.67. The calculated t-value > t-table value, thus rejecting Ho and accepting Ha, indicating a significant difference between learning outcomes before and after using the media.

c. Average Gain Test (N-Gain)

The N-Gain analysis showed an increase of 0.71 (71.43%), which is considered high, indicating that Articulate Storyline-based interactive multimedia is highly effective in improving mathematics learning outcomes in elementary school mathematics on the topic of volume of geometric shapes.

Table 7. N-Gain Test Results Table

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NgainScore	21	.43	1.00	.7143	.14359
NGainPersen	21	42.86	100.00	71.4327	14.35948
Valid N (listwise)	21				

The table shows an average increase (gain) in the pretest and posttest data of 0.71. Therefore, it can be concluded that the use of this media achieved an average increase of 71.43%, with high criteria. This average increase indicates that interactive multimedia based on Articulate Storyline is very effective for use in mathematics learning on the volume of solid shapes in elementary schools. This finding is consistent with the research of Mikelin Ardania (2022), which states that

AR-based learning media can improve learning outcomes by up to 85%. The results of the study indicate that the developed media is feasible, practical, and effective. This media is not only visually appealing but also integrates local cultural aspects through the CRT approach, thus providing a fun and meaningful learning experience and can significantly improve student learning outcomes.

4. Conclusion

Based on the results of research and development of interactive multimedia products based on Articulate Storyline on the material of volume of solid shapes, several conclusions can be drawn. First, this learning media is proven to be valid and suitable for use as a learning tool for sixth grade students. This is supported by the results of the material expert validation test which showed a percentage of 92% with a very valid category, as well as the overall media validation obtained a percentage of 94%, which is also included in the very valid category. Second, this media is practically applied in schools as a supporting tool in delivering material. This is shown from user responses, namely the questionnaire response of sixth grade students of SDN 01 Sengare of 80% and the questionnaire response of teachers of SDN 01 Dororejo of 84%, both of which are in the very good category. This positive response confirms that the media can be used easily and supports the learning process effectively. Third, the effectiveness of the media can be seen from the comparison of the results of the initial test (pretest) and the final test (posttest), which shows an N-Gain value of 0.7143. This indicates a significant increase in student learning outcomes after using Articulate Storyline-based interactive multimedia, so this media can be concluded as effective in improving students' understanding of the volume of geometric shapes. Overall, this study proves that Articulate Storyline-based interactive multimedia is not only valid and practical, but also effective as an engaging mathematics learning medium and can improve student learning outcomes.

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