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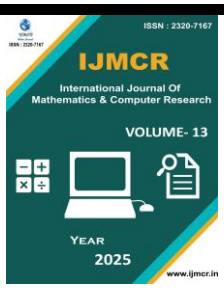

Development of Learning Media in Elementary Schools Assisted by Storyline Application

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ABSTRACT

The development of information and communication technology has had a significant impact on education, demanding innovation in the learning process to meet the demands of 21st-century skills. This research aims to develop interactive learning media based on the Articulate Storyline application for elementary school students. The research uses the Borg and Gall development model through the Define, Design, and Develop stages. In the Define stage, an analysis of student needs, basic competencies, and technology integration in learning is conducted. The Design stage includes the design of learning media involving competency design, learning objectives, and student activities. In the Develop stage, the product is validated by media and material experts, followed by revisions based on the trial results. The research results in a valid and feasible learning media assisted by the Storyline application for use in elementary school mathematics, particularly on the topic of fractions. This media offers advantages such as an attractive visual display, interactive features, and the integration of multimedia elements like text, animations, and videos. The use of this media has been proven to increase students' motivation and understanding of the learning material. This research also produced outputs in the form of educational media products, journal articles, and monographs registered with an ISBN. The next steps include product trials on a wider population and the dissemination of research results.

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KEYWORDS: Learning Media, Technology, Articulate Storyline, Basic Education, Media Development

I. INTRODUCTION

In the era of the 5.0 Industrial Revolution, educational paradigms are rapidly evolving, primarily due to the pervasive influence of information and communication technologies (ICT). These technologies present a significant opportunity to redefine learning processes, particularly in developing a generation equipped with essential 21st-century skills such as critical thinking, creativity, collaboration, and effective communication [1], [2]. It has become essential for educational institutions to create technology-based learning media that align with the needs of modern learners and promote deeper conceptual understanding.

Effective learning media extend beyond mere visual aids; they encompass interactive experiences that actively engage students [3], [4]. In a landscape characterized by rapid technological advancement, leveraging ICT can significantly enhance the learning experience by incorporating engaging audio-visual elements, animation, and interactivity [3], [5]. This engagement is crucial not only for maintaining student interest but also for helping students grasp complex concepts [5]. The integration of multimedia components into educational media can personalize learning, catering to diverse student preferences and learning styles, thus fostering a more inclusive educational environment [6], [7].

To effectively design such interactive learning media, educators must adhere to established pedagogical frameworks, including the Technological Pedagogical Content Knowledge (TPACK) model [8], [9]. This model emphasizes the intersection of technology, pedagogy, and content, ensuring that any educational media developed is not only visually appealing but also pedagogically sound and aligned with curriculum requirements. Specifically, the development of mathematics learning media necessitates a comprehensive understanding of both technological

capabilities and educational principles to facilitate meaningful learning outcomes [10], [11].

Articulate Storyline, a sophisticated software tool, exemplifies a modern solution for creating interactive educational content without requiring advanced programming skills. Its user-friendly interface, resembling familiar programs like PowerPoint, allows educators to design engaging lessons that effectively combine text, imagery, audio, and animations [12], [13]. Such features are critical for developing effective mathematics instructional materials, particularly on topics like fractions, which traditionally pose significant challenges for elementary students [13], [14].

The research aims to develop interactive mathematics learning media focusing on fractions, following the Borg and Gall development model, which includes stages such as needs analysis, design validation, and user testing [15]. Integrating technology and pedagogy into the development process is expected to lead to educational media that not only meets curricular objectives but also enhances student engagement and comprehension. Ultimately, the successful implementation of such innovative, technology-enhanced learning experiences is anticipated to contribute significantly to the quality of primary education, equipping a generation ready to address the complexities of contemporary society [16], [17].

II. METHOD

This research uses the Borg and Gall development model, which is designed to produce effective educational products through a systematic development process. The research focuses on the development of interactive learning media based on the Articulate Storyline application for elementary school students. This model includes three main stages:

Define

This stage aims to analyze the needs and issues relevant to the learning context in Elementary Schools. The steps taken include:

1. Analysis of student needs: Identifying students' understanding levels of the learning material, particularly on the concept of fractions. This analysis is conducted through interviews, observations, and curriculum document studies.
2. Curriculum analysis: Reviewing the relevant curriculum to determine the basic competencies to be achieved.
3. Technology integration: Evaluating the potential use of technology in supporting learning, particularly through the Articulate Storyline application.

Design

This stage, an initial prototype of the learning media is designed, taking into account pedagogical, technological, and content aspects. The steps include:

1. Determining the learning competencies to be achieved.
2. Designing interactive learning scenarios, including storyboards that contain text, images, animations, and videos.
3. Developing interactive elements such as navigation buttons, quizzes, and feedback to enhance student engagement.

Develop

This stage includes the creation of a learning media prototype and its validation. The steps are:

1. Expert validation: The initial prototype was validated by media and material experts to ensure the design aligns with the learning objectives.
2. Field testing: The media was tested on a small group of students to evaluate its effectiveness, engagement, and ease of use.

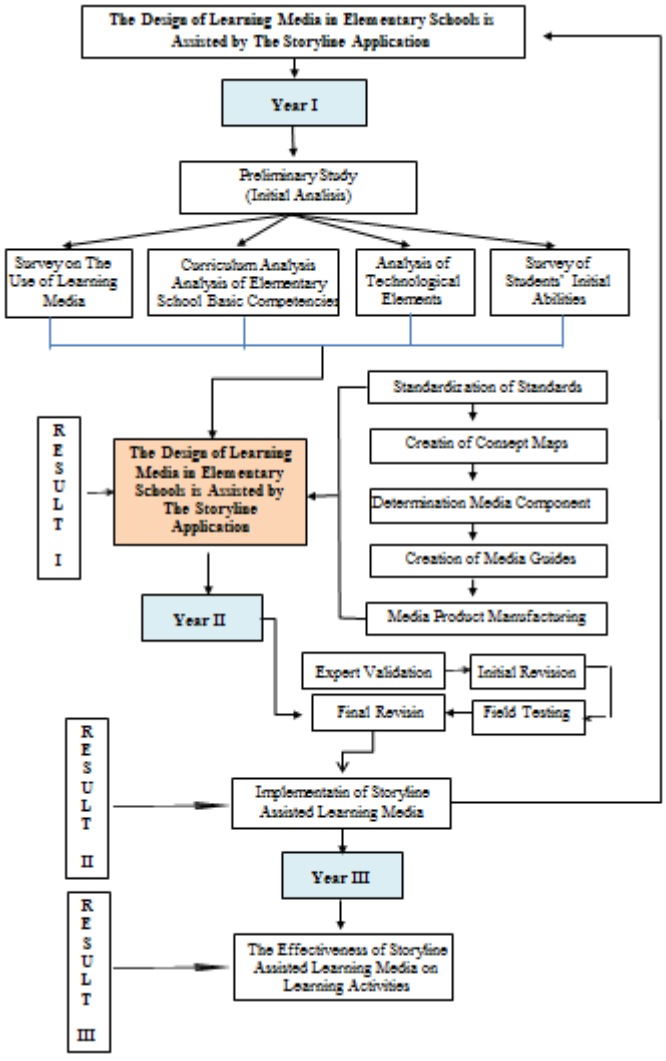


Figure 1. Research Flow Chart

III. RESULT AND DISCUSSION

Result & Discussion of Define step

This research produced interactive learning media based on the Articulate Storyline application, which has gone through the Define, Design, and Develop development stages. This

media is designed for fraction material in Elementary School, with the following results:

Validation of Learning Media Validation by media experts and subject matter experts shows that the learning media meets the validity criteria with the following evaluation results:

Content and Materials: The learning media is deemed relevant to the basic competencies, in accordance with the curriculum, and capable of clearly explaining the concept of fractions.

Result & Discussion of Design step

Media Design: The media has an attractive visual appearance, contrasting colors, and multimedia elements (text, animations, and videos) that support students' understanding.

Interactivity: The media is equipped with navigation buttons, quizzes, and feedback, which encourage students to be more active during learning.

Test Results: The media trial was conducted on a small group of students, with the following results:

Student Engagement: 85% of students are actively involved in using learning media.

Ease of Use: 90% of students reported that the media was easy to use without additional help from the teacher.

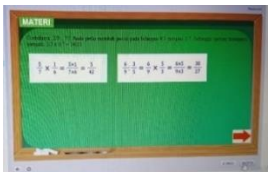
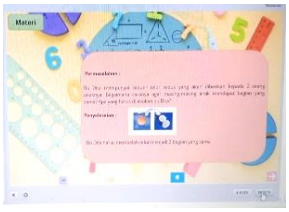
Improvement in Understanding: The results of the pre-test and post-test show an average score increase of 25%, from an average of 60 (pre-test) to 85 (post-test).

Media Revisions: Based on feedback from the trial, several revisions were made, including:

- Adding brief descriptions at each step of the learning process to help students understand the material.
- Improvement of the background color to make it more contrasting and not distracting to students' focus.

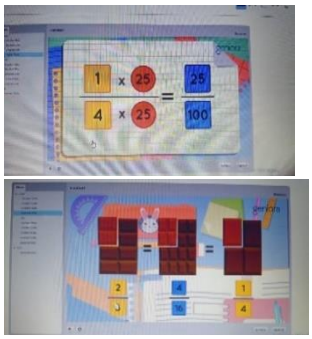
The storyline media underwent significant changes in terms of both usage and appearance. These changes were made based on various inputs received from early users as well as the results of media trials conducted beforehand. The feedback addressed aspects such as ease of use, the flow of information delivery, visual clarity, and the integration of elements within the media. These improvements not only enhanced the aesthetic quality of the media but also contributed to increased effectiveness in delivering the intended message, as evidenced by the improved results of the post-revision trials. The revised results are presented in the following table.

Table 1. Revising of Story Line

Before - After Revising the Story Line	difference
Before  **After** 	Previously: There was no explanation of the material, so it seemed like the students were just playing a game. Correction: Having an explanation about the material so that students understand its purpose.
Before  **After** 	Previously had 4 menu icons and the quiz menu was separate. Correction: has 3 menu icons and the quiz has been integrated into the video menu.
Before    **After** 	Previously: the material taught only consists of definitions and examples. the background does not contrast with its color. Correction: The learning material was improved to include more concrete content that aligns closely with the subject matter, enriched by examples drawn from real-life objects to enhance understanding and relevance. Furthermore, the background was redesigned with colors that harmonize and complement the visual elements, creating a more balanced and visually engaging presentation, thereby improving readability and focus on

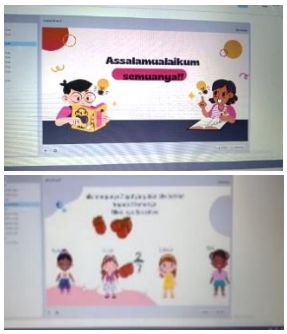
the key content.

Before



Previously: having a learning video that aligns with the concept of fraction learning, but in the application of the fraction learning concept in the video, it turns out to have already covered the core of fractions.

After



Correction: has an educational video corresponding to the title/theme of the lesson, which is the basic concept of fractions, where in the first image of the video it explains the basics and concepts of fractions.

Result & Discussion of Development step

The results of this study, until development step, indicate that learning media based on the Articulate Storyline application is effective in enhancing student engagement and understanding of fraction material. Multimedia features such as animations and videos make it easier for students to understand the concept of fractions, which was previously considered abstract by many students. These findings are in line with the research of Doni (2019) and Siregar (2024), which state that interactive media can enhance student motivation and learning outcomes [13].

Figure 2. Main Menu

The main menu display of this educational media has been designed with a simple and intuitive interface that facilitates navigation for users, particularly students, through the various available features. The menu comprises three main sections: Learning Materials, Learning Objectives, and Learning Videos, each equipped with clear and easily understandable action buttons. Such simplification is intentionally executed to avoid visual and cognitive distractions that could disrupt students' focus during the learning process. Additionally, access to quizzes is not provided directly on the main menu to ensure that students first engage with and comprehend the materials before progressing to the evaluation stage. This approach aligns with cognitive load theory principles, which emphasize the importance of managing cognitive load to enable optimal information processing without interference from irrelevant information [8]. Research indicates that overly complex learning interfaces can lead to mental fatigue and diminish educational effectiveness, supporting the need for a simplified design [18], [19], [20]. Therefore, this clean and structured interface supports a more focused, efficient learning process oriented towards deep understanding.

Furthermore, research conducted by Sweller et al. indicates that effective instructional design takes into account how learners interact with educational content [20]. This study supports the notion that reducing extraneous cognitive load through effective interface design contributes to better retention and comprehension of knowledge. In line with Mayer's multimedia learning principles, a coherent design enhances the educational experience by emphasizing essential content without superfluous elements [21]. Tools that maintain clarity in educational interfaces facilitate enhanced engagement and deeper cognitive processing of materials, ultimately leading to improved academic outcomes [21], [22]. Such strategic design in the menu layout directly addresses challenges identified in educational technology research, affirming the necessity of avoiding unnecessary complexity to sustain learner motivation and active participation [18].

Figure 3. Material with real case

The image presented illustrates the concept of basic fractions, combining explanatory text with real-life examples familiar to students, such as pictures of food items (like eggs, pizza, and cake) cut into parts. This approach is effective for

elementary school students as it helps them understand that fractions are not merely mathematical symbols but also representations of parts of a whole that they frequently encounter in their daily lives. For instance, dividing a pizza into four slices provides a visual and practical understanding of the fraction (1/4). The use of concrete visual media bridges the gap between abstract concepts and real-life experiences, facilitating students' understanding and retention of these concepts.

According to Micallef and Newton, incorporating concrete examples significantly enhances the learning of abstract concepts, particularly in the context of mathematics [23]. When students are presented with tangible representations, they are more likely to grasp the underlying mathematical principles effectively. Furthermore, Wijaya's research highlights the difficulties that some Indonesian fourth graders face with fractions, partially attributing these challenges to insufficient opportunities to learn through relatable examples [9], [22]. The concrete representation of fractions is essential, as Ünlü notes, because such models allow learners to visualize and understand abstract mathematical concepts, making them more accessible.

Bruner's educational theory posits that learning becomes more meaningful when students are introduced to concepts through active experiences (enactive), followed by visual representations (iconic), and, finally, symbolic representations (using numbers and symbols) [24]. This sequence aligns with Piaget's constructivist learning theory, which emphasizes that students build knowledge through direct experiences and connections to prior knowledge, thus facilitating deeper understanding and retention [11], [18], [25]. The emphasis on visual and contextual learning methods aligns with Flores et al.'s advocacy for using the Concrete-Representational-Abstract (CRA) sequence in mathematical instruction, which has been shown to significantly benefit students' understanding of fractions. By leveraging this approach, educators enhance students' comprehension of fractions and promote a more engaging and relevant learning environment.

The use of visual representations, such as the one depicted in the image, is crucial for elementary students' mathematical development. It not only conveys information effectively but also reinforces understanding in a manner that is enjoyable, relevant, and developmentally appropriate, aligning with the cognitive developmental stages outlined by both Bruner and Piaget. The use of attractive icons can also be utilized to explain fraction formulas in a more visual and easily understandable way, as shown in the following image:

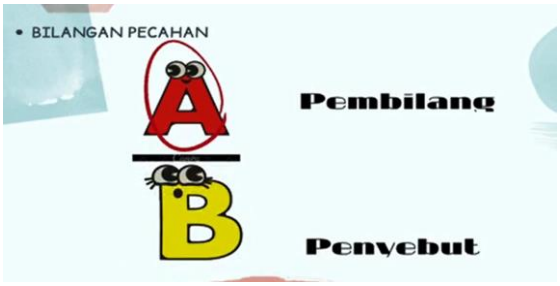


Figure 4. Fraction with fun icon

The image presented showcases the general form of a fraction, represented as A/B, which consists of a numerator (A) and a denominator (B). This representation is delivered through a simple yet engaging animation, where the letters A and B are given expressive and whimsical eyes, enhancing the visual appeal for elementary school students. This visual approach is intentionally designed to assist students in recognizing and remembering the positions and functions of the numerator and denominator more easily. Research indicates that visual aids are crucial in aiding comprehension, especially for younger learners who benefit greatly from concrete representations [26], [27].

Utilizing animation clarifies the basic concepts of fractions and creates a more enjoyable and less monotonous learning environment, thereby supporting meaningful educational experiences. Presenting definitions solely through formal language may prove inadequate for fourth-grade students under 12 years old. At this developmental stage, children typically benefit from concrete representations and hands-on experiences compared to abstract or theoretical explanations [27].

Studies suggest that employing media such as animated visuals significantly impacts the formation of foundational conceptual understanding in mathematics. By engaging with representations that resonate with their developmental needs, students can develop stronger cognitive connections. The transition from concrete to abstract representation is critical in mathematics education, particularly in understanding fractions, as it has been shown that direct interaction with visual models can strengthen their comprehension of fraction magnitudes [28]. Furthermore, animations can serve as a bridge for students to transition from representational to more abstract numerical concepts, thus enhancing their overall mathematical fluency [7], [28].

The use of engaging, animated visuals provides an effective strategy to foster understanding of fractional concepts among young learners, catering to their cognitive development needs. This approach not only makes learning enjoyable but also reinforces their ability to conceptualize and apply mathematical ideas in varied contexts. Questions that are considered difficult can also be presented through engaging animations, so that students do not feel pressured from the beginning and are more motivated to understand the content.

Figure 5. Visualization of Problem

Figure 6. Quiz with countdown and animation

The scenario depicted in the image presents a contextualized problem where a character named Silvi has seven apples to share among her three friends: Niken, Ayu, and Zahwa. This animation not only visually represents the fraction (2/7) but also brings the concept of fractions to life through an engaging activity familiar to students—sharing fruit with friends. This approach significantly aids students in understanding fractions as parts of a whole within a social context they encounter regularly. Visualizing characters and real objects fosters both emotional and cognitive engagement among students, making them more motivated to connect with and grasp the lesson being presented.

Educational materials are more effective when they relate closely to students' real-life experiences [8], [29]. The integration of engaging animations further supports this premise, it indicate that visually appealing and interactive media can enhance students' focus and learning motivation. By providing a relatable story and animated visuals, the lesson clarifies mathematical concepts and creates a pleasurable and meaningful learning experience for students. Furthermore, the use of character-based animations is backed animation contributes positively to the learning process by making educational content more engaging through the non-verbal behaviors of animated characters [19], [30]. Similarly, highlight that animations can improve student engagement and flexibility in self-directed learning, thereby enriching the overall learning experience. These elements underscore the importance of using interactive and relatable materials, which have been shown to effectively promote understanding of mathematical ideas like fractions among young learners.

Employing story-based and animated presentations, educators can not only clarify mathematical concepts but also build enjoyable and meaningful learning experiences that resonate with students, aligning with both contextual learning theories and the cognitive principles of education. A storyline accompanied by illustrated visuals is also effective when used in quizzes, as shown in the following example:

The quiz interface illustrated in the image is designed to be visually engaging and communicative, utilizing familiar watermelon illustrations for students. The question posed is contextualized, asking, "What fraction of the watermelon does Rizky eat if he consumes 1 slice?" This encourages students to apply the concept of fractions in a real-world scenario relevant to their lives. The incorporation of animated characters and appealing fruits creates a fun and non-stressful quiz atmosphere. Additionally, the visible countdown timer (the number "6") adds a time challenge, prompting students to think quickly and answer promptly. This feature not only trains cognitive skills but also builds time management and swift decision-making abilities—crucial skills in 21st-century learning environments Sorge et al. (2019).

Research indicates that time elements in quizzes can enhance student focus and engagement, particularly when wrapped in enjoyable, interactive designs such as this one [21]. The countdown timer creates a sense of urgency that can motivate students to concentrate, fostering a competitive yet enjoyable learning experience. Moreover, the incorporation of contextual problems aligns with the principles of constructivist learning, which emphasize the importance of relevant, relatable scenarios for effective knowledge retention [18], [25].

The animated quiz format, exemplified by smartly integrating both visuals and contextual learning, proves to not only clarify mathematical concepts but also nurture an engaging, supportive learning atmosphere that resonantly echoes students' everyday experiences. By presenting academic content through appealing methodologies, educators can effectively enhance interest and promote active participation among learners [3]. Thus, it is evident that integrating practical examples, time challenges, and engaging formats significantly contributes to improved educational experiences for students.

In this way, it supports the vision of education in the era of the Industrial Revolution 5.0, which emphasizes the integration of technology into learning. This study responds to the growing impact of information and communication technology on education by creating interactive learning media tailored to 21st-century skills. Using the Borg and Gall model, the development process includes Define, Design, and Develop stages. The Define phase identifies student needs, competencies, and classroom technology use. The Design

phase focuses on integrating activities and learning objectives, while the Develop phase involves expert validation and revisions based on trial feedback. The final product is both valid and practical, with clear improvements demonstrated through a comparative analysis of the storyline media before and after revisions. Ultimately, this media contributes to the development of 21st-century skills, such as critical thinking and digital literacy.

Although the media developed is considered valid and effective, there are several challenges encountered during its development and implementation. These include its limited generalizability, as it was specifically designed for fractional material and would require adjustments to be used for other topics. Additionally, the use of application-based platforms like Articulate Storyline demands sufficient technological infrastructure, which may not be available in all elementary schools. Despite these challenges, this research contributes significantly to primary education by providing a technology-based learning tool that not only enhances students' conceptual understanding but also serves as a reference for teachers in developing similar media.

CONCLUSION

This research successfully developed interactive learning media using the Articulate Storyline application to enhance the teaching of fractions in elementary schools. The media was validated by experts and found to be highly appropriate in content, design, and interactivity, aligning well with curriculum goals and user-friendly for students and teachers.Trials showed increased student engagement and a 25% improvement in learning outcomes, demonstrating the media's effectiveness. The integration of multimedia elements offers a dynamic learning experience suited to the demands of the 5.0 Industrial Revolution. This study contributes to the advancement of technology-based education and serves as a reference for similar innovations.

SUGESTION AND RECOMENDATION

Based on the research findings, several recommendations are proposed to enhance the development and implementation of learning media using the Articulate Storyline application. Future development should include a wider range of subjects beyond fractions, such as science, language, and social studies. Large-scale testing across diverse student populations is necessary to evaluate the media's broader effectiveness and accessibility. To increase flexibility, integration with learning management systems (e.g., Google Classroom or Moodle) is recommended, allowing students to access content independently. Additionally, schools need adequate technological infrastructure to support the use of this media, making access to devices a key priority. Lastly, teachers should receive proper training in using Storyline-based media to ensure its effective integration into the classroom learning process.

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