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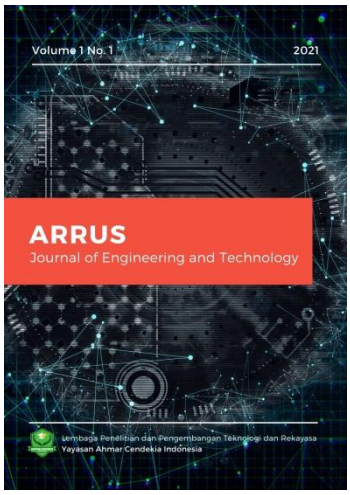

RESEARCH ARTICLE

Design Of An Educational Game For Introducing Flat Shapes To 4th Grade Elementary Students At Sdn Temugiring Using Construct 2

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Abstract: This study aims to design and develop an educational game that serves as an interactive learning medium to introduce the concept of flat shapes to fourth-grade students at SDN Temugiring. In elementary school mathematics, especially on the topic of flat shapes, many students still face difficulties in understanding the forms and characteristics of each shape. Therefore, the use of interactive learning media in the form of educational games is expected to provide a more enjoyable and engaging learning experience for students. The development of this game follows the Multimedia Development Life Cycle (MDLC) method, which consists of several stages: concept formulation, design, material collection, production, testing, and distribution. The game application was developed using Construct 2, as this platform offers an easy-to-understand interface and supports the development of 2D-based games. The results of the study show that this educational game successfully enhances students' understanding of flat shape material and positively impacts their learning motivation in the classroom.

Keywords: Educational Game, Flat Shapes, Elementary Students, Construct 2, Interactive Learning Media

1. Introduction

Education at the elementary level plays a crucial role as the main foundation in shaping students' thinking abilities and character. Mathematics is one of the core subjects introduced from an early stage. This subject is not only concerned with numbers but also includes fundamental concepts such as geometry, which is directly related to daily life, including the introduction of two-dimensional (flat) shapes. Typically, material on flat shapes is introduced in fourth grade, covering the identification of names, forms, and characteristics of shapes such as squares, triangles, and circles (Siregar, 2020).

However, in practice, the process of learning mathematics—particularly in the topic of flat shapes—is still often carried out using traditional methods such as lectures and written exercises. This approach tends to be less engaging, causing students to lose interest quickly and struggle to

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understand the material. Based on preliminary observations at SDN Temugiring, students appeared unenthusiastic during math lessons, especially when the material was delivered only through textual explanations (Hidayati, 2021).

The advancement of information and communication technology (ICT) can be utilized as a supporting tool in education. One of its applications is through game-based learning media. Educational games are considered capable of creating an enjoyable and engaging learning atmosphere, as well as improving students' motivation and understanding of the subject matter (Rahmat & Lestari, 2022). This type of media is particularly suitable for elementary school students as it presents material using attractive visuals, animations, and challenging gameplay elements, thus stimulating their enthusiasm for learning.

To develop an effective educational game, an appropriate platform is essential. One widely used and user-friendly software for game development is Construct 2. Construct 2 is an HTML5-based application that allows for the creation of interactive games without requiring advanced programming skills (Prasetyo, 2022). With its simple interface, Construct 2 is well-suited for developing educational games, especially to support the understanding of flat shapes at the elementary school level.

Under the implementation of the Merdeka Curriculum—which emphasizes differentiated and project-based learning approaches—educational games serve as an innovative method aligned with these principles. Educational games can adapt to various learning styles, whether visual, auditory, or kinesthetic. Therefore, this media not only facilitates material delivery but also contributes to the integrated development of students' cognitive and social skills (Kemendikbudristek, 2022).

The urgency to develop innovative learning media is also supported by various previous studies, which show that the use of educational games can enhance student learning outcomes. For instance, research by Sulastri (2021) revealed that the application of educational games in mathematics lessons significantly improved students' conceptual understanding and daily test scores. This demonstrates that integrating games into the teaching and learning process has a positive impact on academic achievement.

In addition to deepening understanding of the subject matter, educational games also play a role in improving memory and logical thinking skills. Through games, students gain direct and applicable learning experiences. Concepts of flat shapes that were previously studied only theoretically can be better understood through visual and interactive presentations in the form of games, making them easier to grasp and remember (Yuliani & Sari, 2023).

Based on the explanation above, the researcher sees the importance of designing educational game media to introduce the concept of flat shapes to fourth-grade students at SDN Temugiring, utilizing Construct 2 as the development platform. It is expected that this media can be an alternative solution to increase students' enthusiasm for learning, help them understand the material visually and interactively, and create a more enjoyable and effective learning experience in the elementary school environment.

2. Literature Review

2.1. Elementary School Students

Elementary school students are individuals undergoing the early stages of formal education. They are typically between 9 and 10 years old, a crucial period for cognitive, emotional, and social development. At this age, children begin transitioning from a play-oriented environment to a more structured learning process. According to Slamet (2005), children in this stage are in the

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concrete operational phase, characterized by the ability to think logically about concrete objects, although their understanding of abstract concepts is still limited.

Furthermore, Hurlock (1993) describes this period as middle childhood, during which children start developing social skills, building self-confidence, and adapting to broader social environments such as peers and school settings. At this stage, children also begin to understand the importance of rules and cooperation in group activities.

Meanwhile, Santrock (2012) states that children aged 9–10 years are in the psychosocial development stage called industry versus inferiority, based on Erik Erikson's theory. In this phase, children seek learning experiences that help build a sense of accomplishment. When supported and acknowledged by their surroundings, their confidence grows. However, repeated failure without guidance may lead to feelings of inferiority or helplessness.

2.2. Learning Media

Learning media are any tools or resources used to deliver information, stimulate thoughts, emotions, and attention, and enhance students' abilities so that learning can occur optimally. These media may include visual aids, audio, audiovisual, and interactive multimedia, with the primary goal of helping students understand learning material more easily (Arsyad, 2021).

Heinich and colleagues (2020) explain that learning media serve as instructional tools used by educators to deliver material effectively to students. As a bridge between teachers and learners, media make knowledge delivery more engaging, efficient, and meaningful.

According to Sadiman et al. (2022), learning media encompass all elements that stimulate the cognitive, emotional, and attentional aspects of students during learning activities. These are not limited to modern technology but may also include non-digital materials such as pictures, illustrations, or real objects used in the classroom.

2.3. Flat Shapes

Flat shapes are one of the essential topics in elementary mathematics. They refer to two-dimensional forms that have length and width but no height or volume. Common flat shapes introduced to fourth-grade students include squares, rectangles, triangles, circles, trapezoids, and parallelograms (Sari & Hadi, 2022).

Each flat shape has unique characteristics, such as the number of sides, angles, diagonal lengths, and symmetry. Understanding these features is vital for developing students' logical and structured thinking skills. This knowledge also serves as a foundation for learning more advanced geometry in higher education levels (Putra & Hidayat, 2021).

In addition to recognizing the shapes and their properties, students are also taught how to calculate the area and perimeter of each shape. Mastery of these formulas is beneficial not only in academics but also in everyday life, such as measuring land areas or calculating material dimensions (Nurhayati, 2023).

However, many students still struggle to understand and remember the formulas and to distinguish between one shape and another. This may be due to overly theoretical teaching approaches, lack of visualization, and limited use of interactive and relevant learning media (Fauziah & Ramadhan, 2021).

Therefore, teaching flat shapes should adopt a more enjoyable and engaging approach, such as using images, teaching aids, or digital technologies like educational games, which can enhance students' interest and motivation in learning (Astuti & Darmawan, 2022).

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3. Research Method and Materials

3.1. Flowchart of Conceptual Framework

Fourth-grade elementary school students, categorized as early-age learners, are in the concrete operational cognitive development stage according to Jean Piaget's theory. At this stage, children learn more effectively when information is delivered through direct experience and visual media. Therefore, learning methods that are interactive, enjoyable, and closely related to children's world are highly recommended.

The development of educational media in the form of a flat shapes educational application using Construct 2 is expected to help students recognize different types of geometric shapes in a more engaging and easy-to-understand manner. In addition to delivering visual conceptual understanding, this application also aims to increase students' learning motivation, strengthen their memory, and indirectly instill good habits such as recognizing healthy food from an early age. Therefore, the use of technology as an innovative learning tool is essential to suit the characteristics and developmental needs of elementary school students.

Visually, the conceptual framework can be illustrated as follows:

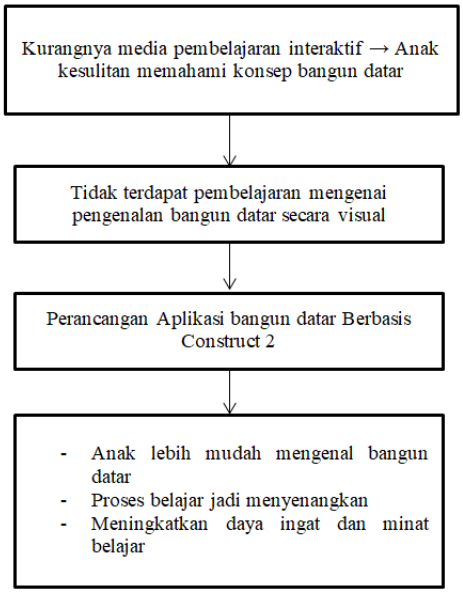

Figure 1. Conceptual Framework

3.2. Needs Analysis

Needs analysis is conducted to identify all requirements for developing a Construct 2-based educational application on fruits. This stage includes analyzing the application's target users and observing similar existing applications as comparison references. The goal of this analysis is to ensure that the developed application meets end-user needs and features relevant and engaging content.

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3.2.1. User Analysis

The main users of this application are first-grade elementary school students, with an average age of around 9 years old. At this stage, children are in the early phase of learning basic concepts such as shapes, colors, and object names around them. Therefore, learning media should be able to attract their interest, be easy to understand, and provide an enjoyable learning experience.

Children at this age tend to be attracted to visual and interactive media. They prefer colorful graphics, bright visuals, engaging sound effects, and game-like activities. Hence, the application's design should be as simple and intuitive as possible, allowing children to operate it without relying heavily on adult assistance.

Additionally, for teachers and parents, this application should also serve as a beneficial tool to support children's learning processes. The content must include clear educational value, such as introducing the names and shapes of fruits, their colors, and benefits, so the learning becomes more meaningful.

3.2.2. Institutional Background

SD Negeri Temugiring is one of the primary education institutions under the supervision of the local District/City Education Office. The school was established to provide basic educational services for the community in Temugiring and surrounding areas. Since its establishment, SDN Temugiring has undergone various developments in terms of facilities, teaching staff, and the quality of education provided.

Initially, SDN Temugiring only had a few basic classrooms and a relatively small number of students. However, over time, public interest in enrolling their children in SDN Temugiring has increased. This encouraged the school to continuously improve its infrastructure and enhance the quality of teaching and learning to produce quality graduates.

As a formal educational institution, SDN Temugiring remains committed to implementing the national curriculum and actively adapting to technological and modern educational developments. The school also actively participates in academic and non-academic competitions and collaborates with various stakeholders to improve the quality of education.

SDN Temugiring envisions developing intelligent, character-driven, and competitive students. Its mission includes improving the quality of learning, building student character through religious and social activities, and creating a safe, comfortable, and supportive learning environment.

3.2.3. Needs Formulation and Solutions

Based on user analysis, existing application comparisons, and multimedia development strategies, the following are the needs formulation and proposed solutions for the development of the flat shapes application:

(1). User Needs

(a). The application must be easy to use with a simple and bright interface, using fun images, animations, and audio guidance to support learning.
(b). The application should provide a feature to monitor children's learning progress, such as progress reports that are easy to understand.

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(2). Functional Requirements

(a). The application must include interactive elements such as games and challenges to increase children's interest in learning.
(b). The application should offer a reporting feature for teachers to evaluate children's learning progress.
(c). The application should be developed using educational game techniques through Construct 2, supporting interactive elements and offering a clear and accessible progress tracking system for children.

(3). Multimedia Data Requirements

(a). The application should use engaging yet simple multimedia such as bright illustrations and easily understood animations.
(b). All multimedia elements must be optimized to ensure the application runs smoothly across various devices.

3.3. Application Algorithm Design

3.3.1. UML (Unified Modeling Language)

(1). Use Case Diagram

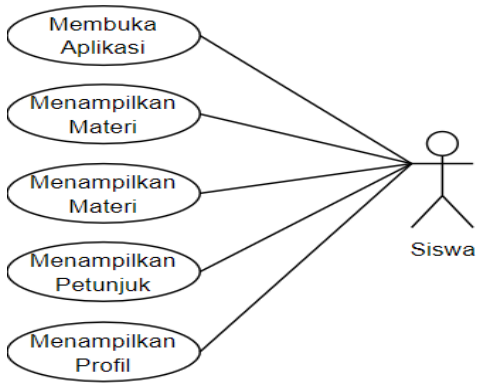

Figure 2. Use Case Diagram

The diagram above shows that there are two entities, namely the teacher and the student. The teacher can open the application, display the learning material, quiz, instructions, and developer profile. Meanwhile, students can view materials and answer quizzes.

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(2). Activity Diagram

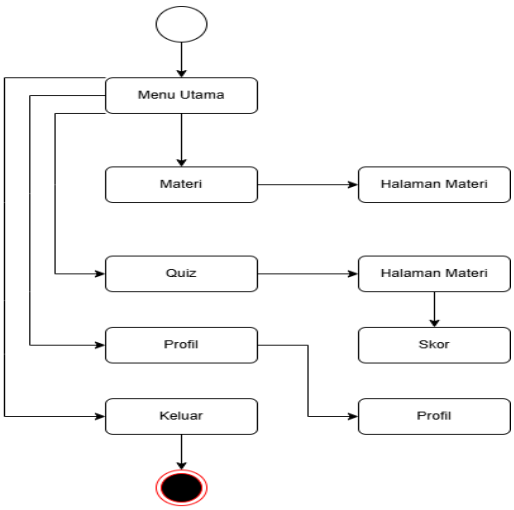

Figure 3. Activity Diagram

The diagram above explains that the teacher begins the lesson by opening the application. The system then displays the main menu. The teacher introduces the material, and the system shows the material menu. The students read and understand the content. The teacher continues to the quiz menu, and students are required to answer the quiz. Then the teacher can also display the instruction menu and profile menu. Once finished, the teacher clicks "exit" and the application closes.

4. Results and Discussion

The design of the application User Interface (UI) is the process of designing the visual layout and interactive elements of the application. The main goal of UI design is to create an intuitive, appealing, and user-friendly interface. Below are several steps commonly taken in UI design, focused on the Bangun Datar (Flat Shapes) application as represented in the previous flowchart:

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Figure 4. Menu UI

The image above shows several buttons, including Exit, Material, Quiz, and Profile. The next interface is the Material UI:

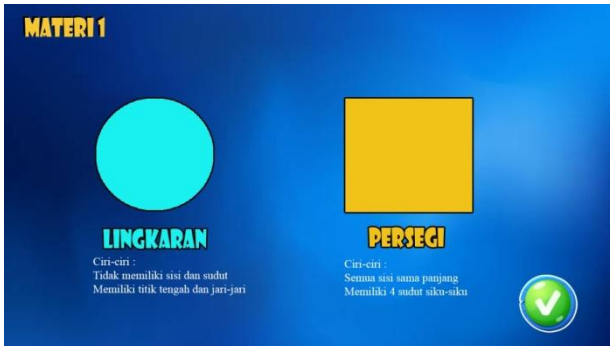

Figure 5. Material UI

The image above shows buttons such as Back and Next, along with a board to display the learning content about flat shapes. The next interface is the Name Input UI:

Figure 6. Name Input UI

The image above shows buttons like Yes and No. The next interface is the Quiz UI:

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Figure 7. Quiz UI

The image above shows interactive elements such as drag-and-drop answer options, score indicators, and health points.

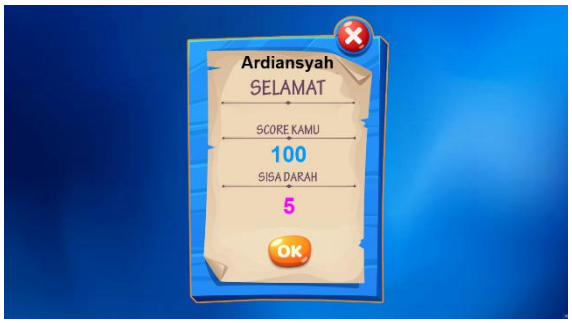

Figure 8. Score UI

The image above includes a button to return to the main menu and a board that displays the user's quiz score. The next interface is the Profile UI:

Figure 9. Profile UI

The image above contains a button to return to the menu and a board that displays the application developer's profile.

4.1. Testing

Black box testing was carried out by running the application with the aim of identifying errors and checking whether the system operates as expected. The black box testing table for this educational game is as follows:

(Note: Please include the table you mentioned to complete this section.)

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Table 1. Black Box Testing of Main Menu

No	Component Tested	Testing Scenario	Expected Result	Test Result
1	Close Icon	Selecting the Close icon provided on the main menu	Exits the application	Passed
2	Music Icon (Mute/Unmute)	Selecting the On/Off music icon on the main menu	Turns background music on and off	Passed
3	Material Button	Selecting the Material button on the main menu	Navigates to learning material	Passed
4	Quiz Button	Selecting the Quiz button on the main menu	Navigates to quiz menu	Passed
5	Profile Button	Selecting the Profile button on the main menu	Navigates to the developer profile page	Passed
6	Instructions Button	Selecting the Instructions button on the main menu	Navigates to the application usage instructions page	Passed
7	Next Button	Selecting the Next button provided on the main menu	Moves to the next slide	Passed

5. Conclusion

Based on the research findings and the development of the basic flat shapes educational application using Construct 2 for elementary school students, the following conclusions can be drawn:

(1). The designed educational application has proven effective in helping students learn about various types of flat shapes in an interactive and enjoyable manner.
(2). The use of Construct 2 as the development platform has proven effective in creating a visually appealing, user-friendly, and interactive application for elementary students.
(3). The application also succeeds in increasing students' learning interest, as the material is presented through games and engaging audio-visual media.
(4). The application received positive feedback from both teachers and students due to its ease of use and alignment with the learning needs at SDN Temugiring.

Based on the discussion and conclusions above, the author offers the following suggestions:

(1). The application can be further developed by adding an evaluation feature (quiz) at the end of the learning session to measure students' comprehension of the material.
(2). Teachers are encouraged to utilize this application as a supplementary learning tool to make the learning process more varied and enjoyable.
(3). Schools are advised to consider the broader application of digital learning media like this across various subjects to align with the advancements in educational technology.
(4). Future research is recommended to quantitatively evaluate the effectiveness of this application by comparing students' learning outcomes before and after using the application.

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