

Development of a Construct 2-Based Educational Game for Flag Recognition Through Word Puzzles in Indonesian Primary Schools

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Abstract

This study aims to develop an interactive educational game titled Flag Letter Puzzle using Construct 2, intended to enhance the learning experience of third-grade students at SDN Patra Manggala 2, Tangerang Regency. The game introduces students to country flags through an engaging word puzzle format that supports both cognitive development and national awareness. The research employed the Research and Development (R&D) approach using the ADDIE model, consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation.

During the analysis stage, observations and interviews were conducted to identify student needs and the relevance of educational media in the classroom. The design phase involved creating the storyboard, interface, and gameplay structure tailored for young learners. The game was developed using Construct 2, enabling integration of visuals, sound, and interactivity. Implementation involved a trial run with 20 students, and the final evaluation was conducted using Black Box Testing and user feedback.

The results showed that all game features functioned properly according to expectations. Students responded positively, displaying high levels of engagement and enjoyment during the learning activities. The intuitive interface and interactive gameplay facilitated independent learning, improved memory retention, and promoted curiosity. The game also aligns well with the 2013 Indonesian curriculum (Kurikulum 2013), particularly in Social Studies and Civics, which emphasize knowledge of national symbols and neighboring countries.

This research concludes that the Flag Letter Puzzle game is both technically feasible and pedagogically effective. It provides a valuable alternative to conventional learning methods by integrating game-based learning into the classroom. The application not only serves as a tool for reinforcing knowledge of country flags but also fosters active learning and digital literacy among elementary school students. The game is recommended for use in similar educational settings to support curriculum delivery and improve learning outcomes through interactive media.

Keywords: educational game, Construct 2, interactive media, elementary education, ADDIE model, country flags.

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1. Introduction

Elementary education is a fundamental stage in shaping students' character and knowledge from an early age. At this level, introducing students to national awareness and general knowledge—such as the flags of countries around the world—is an essential aspect of instilling patriotism and broadening their global perspectives (Zainuddin, 2020). Fun and contextual learning approaches are particularly important for elementary students, who are typically active learners, highly visual, and require interactive stimuli to effectively grasp abstract concepts (Mayer, 2017). In this regard, the development of educational games serves as an innovative strategy to increase student engagement and learning motivation.

Technological advancements have significantly transformed learning processes. One such transformation is the adoption of game-based learning, which utilizes games as educational media that combine entertainment with instructional elements (Plass et al., 2015). Educational games have been proven to improve memory retention and conceptual understanding by providing engaging and interactive experiences (Gee, 2003). Construct 2 is a popular

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platform for developing interactive learning media, as it supports the creation of 2D educational games without requiring complex programming knowledge (Kurniawan & Wibowo, 2021).

In practice, the teaching of world flags is often carried out using conventional methods such as pictures in books or verbal explanations from teachers, which may fail to attract students' attention. This lack of engagement can result in poor understanding of national symbols and global awareness—topics that should ideally be introduced at an early age (Nurhayati, 2022). By implementing an educational game titled Flag Recognition Word Puzzle, students are actively involved in assembling the names of countries based on their flags. This dual-input learning process—visual and textual—encourages two-way interaction and fun learning.

Construct 2 enables the integration of multimedia elements such as animation, sound, and interactivity that greatly enhance student involvement compared to traditional learning methods (Habgood & Ainsworth, 2011). Research by Sun and Hsieh (2020) indicates that interactive games improve learning effectiveness by up to 35% compared to lectures, especially among primary school students. This confirms that educational games are not merely entertaining but also carry substantial pedagogical value.

Furthermore, the implementation of educational games aligns with the Merdeka Belajar curriculum promoted by the Indonesian Ministry of Education, which emphasizes enjoyable, exploratory, and interest-based learning (Kemendikbudristek, 2021). Therefore, the development of the Flag Recognition Word Puzzle game is expected to serve as an innovative learning tool that enhances both motivation and understanding of global citizenship topics.

Educational games also foster the development of cognitive, affective, and psychomotor domains simultaneously. They stimulate logic, memory, and fine motor coordination—particularly in activities such as letter arrangement—which enhances literacy and provides contextual exposure to national identity and global diversity (Prensky, 2001). In this context, the use of symbol recognition and word formation in gameplay strengthens the association between visual representation and meaning.

Based on this background, the present study focuses on the development of an educational game titled Flag Recognition Word Puzzle using Construct 2 for third-grade students at SDN Patra Manggala 2, Tangerang Regency. The final product is intended to serve as an interactive instructional media that can improve students' motivation, interest, and comprehension of the subject of national flags around the world.

2. Literature Review

2.1. Educational Games in Learning

Educational games are a type of game application specifically designed for educational purposes, where entertainment and learning elements are combined harmoniously to enhance learning motivation and effectiveness (Squire, 2011). In the context of elementary school students, educational games have been shown to positively affect academic achievement and cognitive development, as they provide enjoyable and non-monotonous learning experiences (Granic, Lobel, & Engels, 2014). This aligns with the constructivist learning theory, which emphasizes the importance of meaningful and active learning experiences for students (Jonassen, 1999).

As technology evolves, educational games are increasingly integrated across all educational levels, from early childhood to higher education. According to Charsky (2010), the success of educational games lies in their ability to create interactive learning environments that are challenging and provide immediate feedback to users. This makes games effective tools for developing critical thinking, problem-solving, and concept reinforcement skills.

2.2. Interactive Media and Children's Cognition

The use of interactive media is crucial in supporting children's learning because it provides both visual and audio stimuli that strengthen information processing (Clark & Mayer, 2016). Media involving direct interaction—such as games—are superior in delivering educational content because they enable learners to actively participate in the learning process (Moreno & Mayer, 2007). In elementary education, active student engagement is a key indicator of successful learning outcomes (Piaget, 1972). Children better understand abstract concepts when they are presented through attractive visualizations and hands-on experiences.

According to Shute and Ke (2012), game-based interactive media enhances working memory function and conceptual understanding. Educational games allow repeated exposure to learning material through gameplay activities, which ultimately reinforces memory and comprehension.

2.3. Country Flags and Global Education

Introducing country flags as national identity symbols is part of global citizenship education, which should be instilled from an early age. National symbols such as flags, anthems, and emblems help build students' understanding of national identity and diversity (Banks, 2008). According to UNESCO (2015), global education encompasses cross-national knowledge, multiculturalism, and tolerance—concepts that can be introduced through relevant and contextual approaches like learning about national symbols.

At the elementary school level, children are in the concrete operational stage (as per Piaget), during which they can understand classification and symbol identification. Introducing country flags through visual and interactive educational media is thus an effective strategy. Word puzzle games, like the one developed in this study, help students associate visual input (flags) with phonetic input (country names), thereby reinforcing the connection between symbol and meaning (Brown & Larson-Hall, 2012).

2.4. Construct 2 Platform in Game Development

Construct 2 is an HTML5-based 2D game development software designed for non-programmers with a drag-and-drop interface that facilitates the creation of educational applications (Scirra, 2019). It supports the development of simple to moderately complex educational games that can be exported to platforms such as Android, iOS, and web browsers. Construct 2 is widely used in educational settings due to its ability to quickly prototype interactive learning media.

Research by Rahmadani et al. (2022) shows that Construct 2-based learning media significantly increases student interest and engagement, reaching up to 80% effectiveness. Additionally, media developed with Construct 2 are considered stable and compatible across various devices, making them ideal for use in elementary schools with limited technological infrastructure.

2.5. Relevant Learning Theories

This study is grounded in both behaviorist and cognitivist learning theories. Behaviorism, as proposed by Skinner (1953), emphasizes the importance of stimulus and response in the learning process. In the context of educational games, each game level serves as a stimulus that triggers students' learning responses. Cognitivism, on the other hand, focuses on the active role of learners in understanding and organizing information (Bruner, 1966). Game-based learning encourages students to develop their understanding through direct engagement and information exploration.

Moreover, the concept of gamification—the use of game elements such as points, levels, and rewards in non-game contexts—is also relevant. According to Deterding et al. (2011), gamification increases user engagement and motivation. Hamari et al. (2014) also confirm that gamification has a positive impact on intrinsic motivation and academic achievement.

3. Methods

3.1. Research Approach

This research adopts a Research and Development (R&D) approach, aiming to produce an educational media product in the form of an interactive educational game. This approach is considered appropriate as it focuses on developing technological innovations for education and testing their effectiveness with learners (Sugiyono, 2019). The R&D method emphasizes not only the final product but also the systematic development process, expert validation, and user trials.

The development model used in this research refers to the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This model is widely used in instructional media development because of its flexibility and systematic stages that ensure the creation of effective learning products (Branch, 2009).

3.2. Research Subjects and Objects

The object of this research is an interactive learning media in the form of an educational game titled Flag Recognition Word Puzzle, developed using Construct 2. The research subjects are third-grade students at SDN Patra Manggala 2, Tangerang Regency, chosen for their cognitive development stage and the suitability of the learning material with their curriculum.

3.3. Development Procedure

The development procedure follows the five phases of the ADDIE model, as outlined below:

3.3.1. Analysis

This phase involves conducting field observations and interviews with class teachers to identify learning needs and determine the type of media suitable for students. Curriculum analysis is also carried out to ensure the game content aligns with the applicable basic competencies.

The needs analysis stage was conducted to gain an in-depth understanding of the actual classroom conditions at SDN Patra Manggala 2, particularly in Grade III. This process was carried out using two primary methods: direct classroom observation and semi-structured interviews with the homeroom teacher.

1). Classroom Observation

Based on the observations made during learning activities in Grade III at SDN Patra Manggala 2, it was found that instructional media used by the teacher still relied heavily on conventional methods, such as chalkboards and printed textbooks. In lessons related to the introduction of national symbols—such as country flags and names—students were only shown static images from the thematic book, with no use of interactive media that could enhance engagement and understanding.

Additionally, it was observed that students quickly lost focus during lectures longer than 20 minutes. Some students showed increased interest when the teacher used visual materials or simple teaching aids like posters of world flags. This indicates that third-grade students tend to exhibit visual and kinesthetic learning characteristics, which require more interactive and engaging instructional approaches.

2). Teacher Interview

An interview was conducted with the Grade III homeroom teacher, Mrs. Dwi Rahmawati, S.Pd. She explained that the students were highly enthusiastic when learning activities involved games or light competitions. The teacher also revealed that while content related to world countries and their flags is included in the thematic book, it is usually delivered passively and lacks engagement.

She believes that students are more likely to recognize and remember country names when the learning process includes fun activities such as word puzzles or image guessing games. She also mentioned that digital game-based learning media had never been used in class due to the lack of resources and time constraints on the teacher's side. Nevertheless, she fully supports the development of innovative interactive learning media, especially those that can be run on Android devices—which some students own—or through the school's classroom projector.

3). Curriculum Review

A review of the 2013 Indonesian National Curriculum (K-13), revised edition for Grade III under the themes "Weather Changes" and "Technological Developments", shows that topics such as country flags, neighboring countries, and the introduction of national symbols are included in Social Studies (IPS) and Civics Education (PPKn) subject matter. The relevant Basic Competencies (Kompetensi Dasar/KD) include:

Social Studies KD 3.1: Identifying Indonesia's geographical location and neighboring countries.

Civics KD 3.2: Recognizing national symbols and their meanings.

Therefore, the educational game Flag Recognition Word Puzzle is highly relevant to supporting the achievement of these competencies. The game integrates visual elements (flags), letter-arranging word games (country names), and audio narration to support multi-sensory learning experiences in the classroom.

3.3.2. Design

At this stage, a storyboard is created, including the user navigation flow and game structure. The design includes visual components (flags), word puzzle elements, and feedback mechanisms.

1) Use Case Diagram

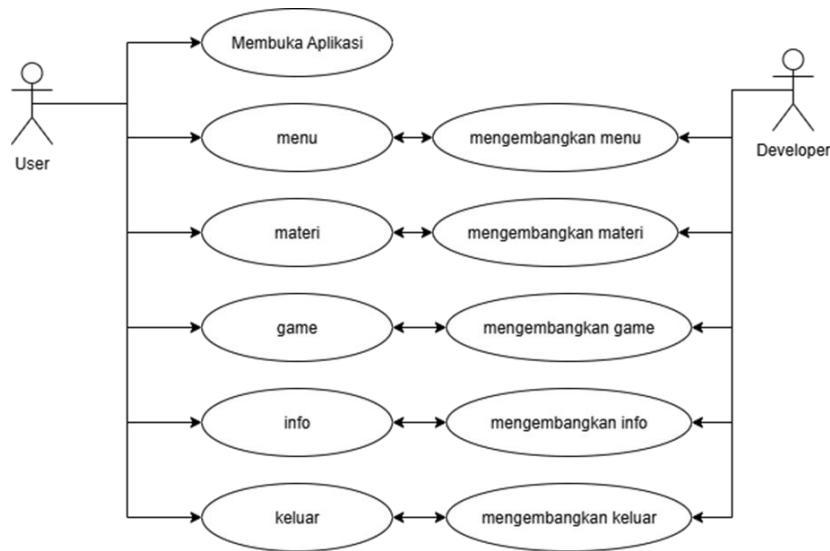


Figure 1. Use Case Diagram

In the image above, it can be seen that the student/user is able to open the application, access learning materials, play games, and view the developer's profile. The student serves as the primary user: reading the materials, answering quizzes, and playing interactively. All interactions are carried out through a simple, interactive, and child-friendly interface developed using Construct 2.

2) Activity Diagram

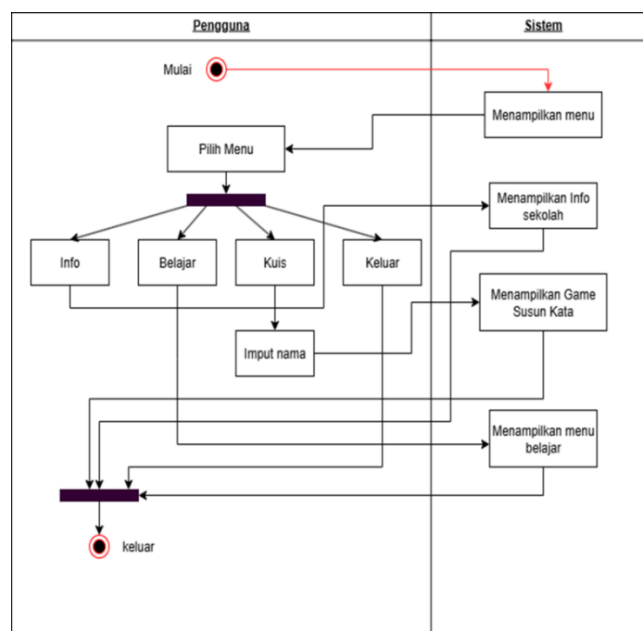


Figure 2. Activity Diagram

The image above illustrates that the user begins by opening the application, after which the system displays the main menu. The user then selects the learning material, and the system presents the material menu for the user to read and understand. Next, the system displays a quiz menu, where the user is required to answer the quiz. The teacher may access the profile menu, and the system will display the developer’s profile. Once all activities are completed, the user clicks the exit button, and the system will close.

3) User Interface

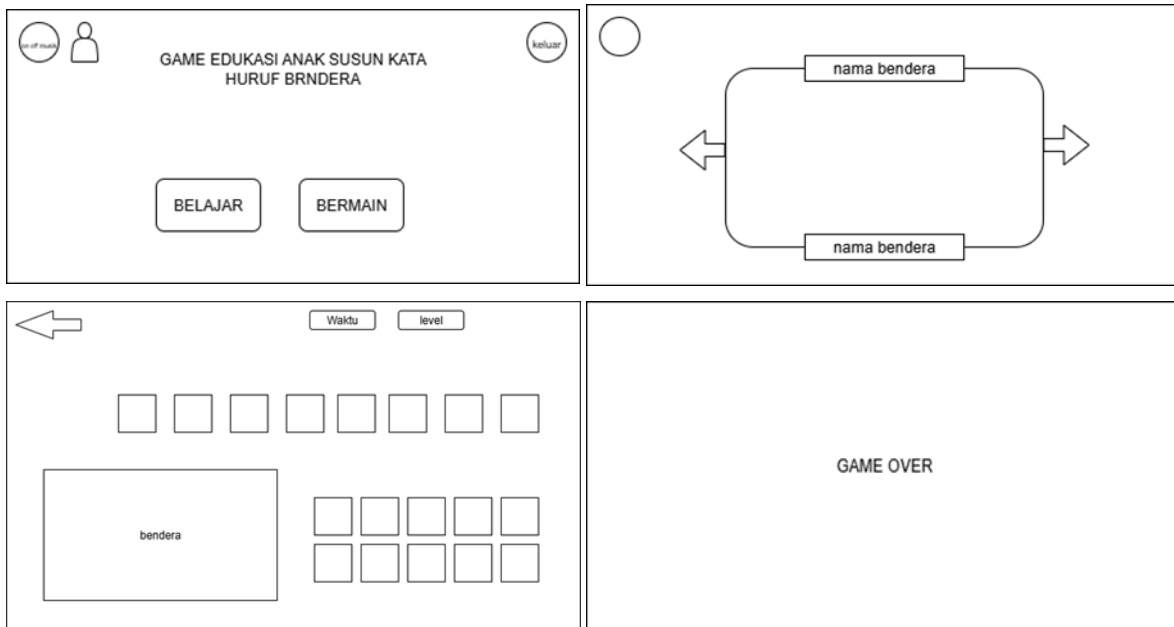


Figure 3. UI Game

User Interface (UI) design is a crucial stage in application development, focusing on the visual layout and interaction flow between the user and the system. The main goal of UI design is to create an intuitive, engaging, and user-friendly interface, enabling users to interact with the application efficiently and enjoyably. In the context of developing the Flag Letter Puzzle application, the UI is designed to support an interactive learning experience for students, particularly at the elementary education level. The interface must be able to present learning materials and game features in a visually simple yet communicative manner, so that students can easily understand the tasks presented in each game session.

3.3.3. Development

This phase involves the actual creation of the game using Construct 2. It includes user interface design, gameplay logic, scoring systems, and audiovisual integration. The developed game is then validated by media experts and subject matter experts.





Figure 4. Game Development

3.3.4. Implementation

The game is implemented through a trial with 20 third-grade students at SDN Patra Manggala 2. This stage aims to collect data on user engagement, ease of use, and content suitability.

The implementation stage is the process of applying the developed media into a real user environment to assess how well it can be utilized by the target audience. In this study, implementation was carried out after the design and development phases of the Flag Letter Puzzle application were completed using Construct 2. The application was then tested by third-grade students at SDN Patra Manggala 2, Tangerang Regency, as the main users.

This educational media was implemented on Android-based devices and could also be run on a laptop using an emulator or directly via a web browser. The installation process was assisted by the class teacher, and students were given a brief guide on how to operate the application—from opening the app, navigating the menu, reading the material, to answering interactive quizzes.

During implementation, students appeared enthusiastic and showed high interest while interacting with the game features. The simple user interface and use of visual elements such as country flags and colorful letters helped students easily understand the instructions within the game. Some students required guidance at the beginning, but overall, the application was used independently after a short explanation.

The application consists of three main menus: Materials, Quiz, and Profile.

- 1) In the Materials menu, students can read information about selected country flags, accompanied by visual images and simple explanations.
- 2) In the Quiz menu, students are asked to arrange letters to form the name of a country based on the displayed flag. If the answer is correct, the application provides positive feedback in the form of sound and animation. If incorrect, students are given the opportunity to try again.
- 3) The Profile menu displays information about the developer as a form of transparency and acknowledgment.

All interaction processes are designed to support independent learning and enhance students' memory of world national symbols. This implementation also serves as a preliminary evaluation stage to assess the practicality and appeal of the media before proceeding to the validation and learning outcome assessment phases.

3.3.5. Evaluation

Evaluation is carried out in two stages: formative (during development) and summative (after product trial) to assess the quality, effectiveness, and user responses to the developed media.

Table 1. Black Box Testing

No	Component Tested	Testing Scenario	Expected Result	Test Result
1	Close Icon	Selecting the Close Icon provided in the main menu	Exit the application	Successful
2	Music Icon (Mute/Unmute)	Selecting the On/Off Icon provided in the main menu	Turn background music on and off	Successful

3	Material Button	Selecting the Material button provided in the main menu	Access the learning material section	Successful
4	Game Button	Selecting the Game button provided in the main menu	Navigate to the Game menu	Successful
5	Profile Button	Selecting the Profile button provided in the main menu	Navigate to the developer's profile page	Successful

Based on the results of the Black Box Testing in Table 4.2, it can be concluded that all components in the main menu of the Flag Letter Puzzle application function properly and as expected. Each button and icon—including the Close Icon, Music (Mute/Unmute) Icon, Material Button, Game Button, and Profile Button—successfully performed their intended functions without errors or failures during testing. This indicates that the main menu interface is operational, user-friendly, and reliable, making it ready for use in real classroom learning environments.

4. Result and Discussion

4.1. Testing Results

The testing phase in this study was carried out using the Black Box Testing method. This approach focuses on testing the functionality of the application without examining the internal code structure. Each function and button on the application was tested based on user input and the expected output. The goal was to ensure that all features worked properly according to the design specifications and user requirements.

The tests were conducted on the Flag Letter Puzzle game application that had been developed using Construct 2. The testing involved simulating how users (students and teachers) interact with the application's main features, such as navigation buttons, sound control, game functionality, and profile display.

The results of the Black Box Testing showed that all key components in the main menu—including the Close Icon, Music Toggle, Material Button, Game Button, and Profile Button—functioned as expected. The interface successfully responded to user commands without any technical errors. For example:

- 1) The Close Icon immediately exited the application when clicked.
- 2) The Music Icon effectively toggled the background music on and off.
- 3) The Material Button opened the educational content as intended.
- 4) The Game Button redirected users to the interactive quiz menu.
- 5) The Profile Button displayed the developer's information page correctly.

This testing ensured that the application was technically feasible and user-ready, particularly for elementary school students who require intuitive and responsive interaction mechanisms.

4.2. Discussion

The testing and implementation results of the Flag Letter Puzzle application demonstrated that the game was both technically functional and pedagogically appropriate for third-grade elementary school students. This supports previous studies stating that well-designed interactive media can significantly enhance children's learning engagement and conceptual understanding (Clark & Mayer, 2016; Shute & Ke, 2012).

4.2.1. Technical Functionality

From a technical perspective, all interactive components worked as intended. The application was developed with simplicity in mind, prioritizing child-friendly design and responsive navigation. The interface incorporated large, colorful buttons, simple text, and clear instructions—features that align with the cognitive characteristics of young learners (Piaget, 1972).

Construct 2, as the development platform, played a crucial role in enabling rapid prototyping, drag-and-drop interactivity, and multimedia integration such as images, sound effects, and animations. These features were optimized to deliver an engaging experience without overwhelming the learner.

The success of all functional elements during testing suggests that the application is ready for broader classroom use. This includes implementation in learning centers, digital literacy programs, or as a supporting tool in thematic subjects related to civics and global awareness.

4.2.2. User Experience and Engagement

Observation during the implementation revealed that students were highly engaged while using the application. Many students expressed enjoyment when playing the quiz section, particularly due to the use of real flags, the challenge of forming correct country names, and the presence of visual feedback (e.g., sounds and animations). This aligns with the concept of intrinsic motivation in game-based learning, where learners engage not just for extrinsic rewards but because the learning itself is enjoyable (Malone & Lepper, 1987).

The positive response from students also highlights the potential of gamification strategies in elementary education. Integrating gaming elements—such as scoring, levels, and feedback—into instructional materials can stimulate curiosity and increase time-on-task, both of which are critical factors in effective learning (Hamari et al., 2014).

4.2.3. Alignment with Curriculum

The application's content was also reviewed to ensure alignment with the 2013 Indonesian Curriculum (Kurikulum 2013). The material on flags and country names fits well within the social studies and civics education objectives, particularly the competencies concerning the identification of neighboring countries and national symbols. This alignment ensures that the use of the application not only increases engagement but also contributes directly to learning outcomes targeted by the national curriculum.

4.2.4. Practical Implications

The testing results also demonstrated that the application could be operated using various devices such as Android phones and Windows-based PCs. This flexibility is vital in supporting the digital learning ecosystem in schools with limited infrastructure. With minimal training, both students and teachers were able to use the application independently, indicating a high level of usability and accessibility.

Furthermore, this media can serve as a supplementary tool during thematic learning sessions or be integrated into digital-based learning modules. Teachers can use the game as an ice-breaker, reinforcement activity, or even as part of formative assessment strategies.

5. Conclusion

Based on the development, implementation, and testing processes of the Flag Letter Puzzle educational game using Construct 2, several conclusions can be drawn:

- 1) The development of an educational game using the ADDIE model has proven effective in guiding each stage of production—from analysis, design, and development, to implementation and evaluation. The resulting product aligns with the learning needs of elementary school students and is relevant to the curriculum.
- 2) The implementation of the Flag Letter Puzzle game in a third-grade classroom setting at SDN Patra Manggala 2 demonstrated that the application was well-received by students. It offered an interactive and enjoyable learning experience, particularly in learning about national flags and country names.
- 3) The results of the Black Box Testing showed that all functional components of the application, such as the material menu, game features, profile display, and music/exit buttons, worked properly and met the expected outcomes without error.
- 4) The game succeeded in creating a child-friendly, engaging, and motivating learning environment. Students were actively involved in learning activities and exhibited high enthusiasm while interacting with the game elements.
- 5) Overall, the Flag Letter Puzzle application can be concluded as technically feasible, pedagogically appropriate, and practical for use as an interactive learning media in elementary education—supporting both the national curriculum and the development of global knowledge among young learners.

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