

Design and Evaluation of an Android-Based Educational Game to Support Animal Recognition Learning for Early Childhood at TK Aisyiyah 03

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A B S T R A C T

Instilling basic knowledge during early childhood is a critical foundation for the development of cognitive, social, and emotional abilities. To support this developmental stage, learning media must not only be informative but also engaging and interactive, reflecting the unique characteristics of how young children learn. One key subject at the kindergarten level is animal recognition, which includes identifying animal names, sounds, shapes, and habitats. However, conventional teaching methods often struggle to maintain children's attention, resulting in reduced focus and limited learning outcomes. To address this issue, the present study developed an Android-based educational game specifically designed to support animal recognition learning at TK Aisyiyah 03. This initiative applies the Research and Development (R&D) method, utilizing the ADDIE development model, which comprises five stages: Analysis, Design, Development, Implementation, and Evaluation. The resulting application features a variety of animals presented through appealing visuals, suitable sound effects, and interactive quizzes that aim to reinforce children's comprehension. The interface is carefully designed to align with the cognitive and motor skills of 4–5-year-old children, enabling both independent use and teacher-guided instruction. Trial implementation involving 15 students demonstrated that the educational game effectively increased interest, active participation, and understanding of animal names and characteristics. Students showed high levels of enthusiasm and responded positively to the learning process. Additionally, validation by content and media experts indicated the application's high feasibility, with an average score exceeding 85% for content, appearance, and interactivity. Further findings reveal the game's ability to enhance learning effectiveness, as evidenced by improvements in students' evaluation results from pre-test to post-test. Teachers and students also gave positive feedback regarding the game as a learning medium. By incorporating the principle of "learning through play," the application addresses the limitations of conventional media, offering a more interactive and enjoyable learning experience. In terms of practicality, the game is easy to implement in classroom settings, being compatible with commonly available mobile devices and operable offline after download, thus requiring no internet connection.

INTRODUCTION

Childhood is a fundamental phase in individual development. Early childhood represents the golden age, a crucial period for shaping cognitive, language, social, and emotional abilities. At this stage, a child's brain develops rapidly, and appropriate stimulation can have long-term effects on future learning processes. One important form of basic stimulation is introducing children to their environment, including recognizing various animals. This not only broadens their knowledge but also fosters empathy toward living creatures.

However, early childhood education (ECE) in Indonesia still faces significant challenges. According to data from the

Ministry of Education, Culture, Research, and Technology (Kemendikbudristek) [1] in 2023, over 60% of ECE institutions still rely on conventional teaching methods with minimal integration of technology. Furthermore, a National Early Childhood Education Survey conducted by BAPPENAS revealed that only about 35% of ECE students have access to interactive, digital-based learning media. This highlights a gap between technological development and its implementation in early childhood education.

The situation is worsened by a lack of contextual and engaging teaching materials. Traditional media such as books or worksheets often fail to hold children's attention for long periods, given that early childhood learning requires simultaneous visual, motor, and sensory activities. On the other hand, the use of Android-based mobile devices in Indonesia has grown rapidly. Data from the Indonesian Internet Service Providers Association (APJII) in 2023 shows that over 70% of households in Indonesia have access to Android devices. This opens a significant opportunity to develop accessible digital learning media, including in the form of interactive educational games.

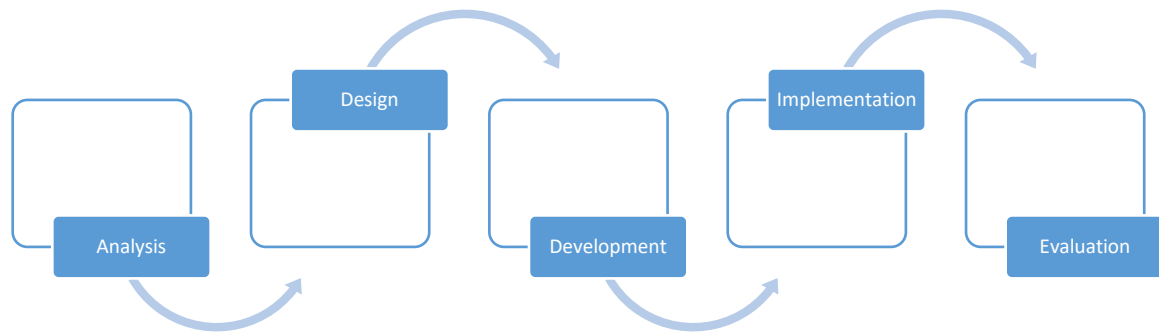
Android-based educational games have the potential to serve as alternative learning media tailored to the needs of young children [2][3]. By leveraging audiovisual features and enjoyable gameplay elements, children can engage in learning through play (learning by playing), a pedagogical approach aligned with ECE principles [4]. Therefore, the development of an Android-based educational game for animal recognition becomes a relevant solution to address the need for learning media that is engaging, accessible, and educational. Through this research, an educational game was developed to assist animal recognition learning for early childhood students at TK Aisyiyah 03 [5]. This media is expected to be an innovative learning tool that supports optimal child development and encourages technology integration in early childhood education in Indonesia.

LITERATURE REVIEW

1. Importance of Animal Recognition Learning for Early Childhood
At an early age, children are in a phase of rapid brain development, with more than 100 billion brain cells interconnected. Early childhood education aims to provide educational stimuli to support physical and spiritual growth and development so that children are prepared for [6]the next level of education. Recognizing colors and shapes is an important aspect of children's learning to develop cognitive abilities [7].
2. The Role of Technology in Early Childhood Learning
The use of technology, such as Android-based educational games, can be an effective learning medium for young children. Educational games can help children [8]learn letters, numbers, animals, fruits, and professions through fun and interactive methods[9].
3. Design of Educational Games for Animal Recognition
The design of educational games for animal recognition in early childhood should consider the following aspects:
 - a. Relevant Content [10]
The material presented should be appropriate for the child's age and level of understanding, such as introducing various animal species and their habitats[11][12].
 - b. Interactivity
The game should be designed so that children can actively interact, for example, through games involving animal sounds to improve memory and understanding [13].
 - c. Attractive Visuals and Audio
Using appealing graphics and clear sounds can increase children's interest and engagement in the learning process.
4. Evaluation and Implementation of Educational Games
Evaluation of educational games is important to ensure their effectiveness in supporting learning. Testing can be conducted through trials at kindergartens or other educational institutions to measure children's comprehension of the material presented and user satisfaction levels.

METHOD

The ADDIE model [14] is one of the most commonly used instructional development models for designing and developing learning products, including media such as Android-based educational games. This model consists of five main stages:



Gambar 1. Metode ADDIE [15]

1. Analysis

In the Analysis stage of the ADDIE model, user needs, learner characteristics, and intended learning objectives are identified. In the context of developing an educational game for animal recognition at TK Aisyiyah 03, the analysis began with interviews with classroom teachers to explore the need for engaging learning media suited to the characteristics of early childhood learners [16][17]. In addition, direct classroom observations were conducted to understand the ongoing teaching and learning processes as well as the approaches being used. Analyzing learner characteristics was also a key focus, such as identifying the dominant learning styles of 4–5-year-old children, who are generally visual and kinesthetic learners with a strong interest in play-based activities [18] [19]. The learning content to be included in the game was then determined, covering types of animals, animal sounds, and their habitats. Based on the results of this analysis, the learning objective was established: for children to be able to recognize and correctly name at least 10 types of animals after using the developed educational game.

2. Design

The Design stage is the process of planning and designing the learning media, which includes the structure, flow, interface, and content to be presented in the educational game. In developing the animal recognition game at TK Aisyiyah 03, this stage began with the creation of a storyboard and flowchart to visually and systematically depict the game's progression [20] [9]. Next, a child-friendly user interface (UI) [18][21] was designed, taking into account the use of bright colors, appealing icons, and a simple layout. Visual elements such as animal illustrations, animations, and interactive icons were selected to match the interests and abilities of early childhood learners, supported by audio elements like animal sounds and simple narration. The types of activities in the game were also designed to be varied, such as drag-and-drop games, image guessing, and matching animal sounds, to increase children's engagement. In addition, the game's navigation and controls were made as simple as possible to ensure that children can use it independently. As part of the evaluation planning, simple pre-test and post-test scenarios were also developed to measure children's understanding before and after using the game media.

3. Development

In the Development stage, the previously designed plans are realized into a tangible product—the initial version of the educational game. The development was carried out using tools such as Unity or Android Studio to build a stable Android-based application that is compatible with the devices used at school [22]. Animal illustrations were designed to be attractive and tailored to children's preferences, enhanced with simple animations and realistic sound effects to create an enjoyable learning experience. Interactive features were added, such as responses triggered when a child clicks on an animal image, automatically displaying the animal's name and sound. Once the initial development was complete, internal testing or alpha testing was conducted to ensure that all functions worked properly and that no bugs interfered with gameplay. Based on the testing results and feedback from educational media experts and early childhood education practitioners, adjustments and refinements were made to ensure the game truly met the needs and abilities of young children.

4. Implementation

The Implementation stage involves conducting trials of the educational game with end users—namely, the children at TK Aisyiyah 03 [23]. This activity began with the teacher introducing the game in the classroom, where the children were shown how to use the application and the purpose of the game. The children were then given the opportunity to try playing, both individually and in small groups, to help them focus and better understand the game content[24]. During the activity, the teacher accompanied and observed the children's

behavior, including how they interacted with the interface, followed instructions, and responded to various features in the game. The teacher also provided guidance and simple assistance when children had difficulty operating the application. Additionally, data were collected through direct observation and questionnaires filled out by the teacher to assess how well the game supported the learning process, captured children's attention, and aligned with the established learning objectives.

5. Evaluation

The Evaluation stage is conducted to assess both the effectiveness and efficiency of the developed learning media, as well as to verify that the intended learning objectives are achieved. In the ADDIE model, evaluation is categorized into two types: formative and summative. Formative evaluation occurs continuously throughout the development process—from the analysis stage through implementation—with the goal of making improvements and refinements based on feedback from teachers, educational media experts, and initial trial results. For example, teachers may provide input when children face difficulties using certain game features, enabling the developers to make timely adjustments.

Summative evaluation, on the other hand, is carried out after the full implementation of the game with the target learners. This evaluation uses both quantitative and qualitative methods to measure the overall success of the product. The quantitative component involves pre-test and post-test assessments administered to the children to objectively measure improvements in their understanding of animal recognition material. The pre-test establishes baseline knowledge before using the game, while the post-test evaluates learning gains after the intervention. Complementing this, qualitative data is collected through teacher questionnaires designed to capture observations regarding children's engagement, participation, and behavioral responses during the learning process. These questionnaires provide valuable insights into the practical usability of the game and its impact on learning dynamics from the educator's perspective.

Together, the quantitative test results and qualitative questionnaire feedback form a comprehensive basis for concluding the educational game's effectiveness and identifying areas for future development and improvement.

RESULTS AND DISCUSSION

Results

1. Analysis

The purpose of developing this educational game is to provide an alternative learning media for animal recognition that can be used by both teachers and parents to educate children. The content concept of this educational game consists of four main menus: a learning menu, a puzzle menu, and a coloring menu.

a. Learning Menu

The Learning Menu contains various animated animal images along with written and spoken information about the animal names in both Indonesian and English. Additionally, the game provides audio for the spelling of each animal's name in Indonesian, allowing children to also learn how to spell words through the application. This combination of visuals, audio, and text helps children improve their vocabulary, pronunciation, and spelling skills in a fun and interactive way.

b. Puzzle Menu

The Puzzle Menu contains a variety of images that children can choose from. Once an image is selected, it is automatically turned into randomized puzzle pieces, which the child can then assemble on a puzzle board. This activity aims to enhance children's cognitive and motor skills, such as problem-solving, spatial awareness, and hand-eye coordination, through fun and engaging gameplay.

c. Coloring Menu

The Coloring Menu contains a selection of images that children can choose from. Once an image is selected, it becomes a coloring canvas. This menu includes a color palette as a color picker, allowing children to choose their preferred colors. It also features a brush size selector, enabling users to adjust the brush size for more detailed or broader coloring strokes. This activity helps children develop creativity, fine motor skills, and color recognition, while providing an enjoyable and interactive artistic experience.

2. Design

The Design stage includes planning the application flow and designing the user interface or mockup. The application flow is designed using a flowchart, while the interface mockups are created using Figma. The

mockup design involves laying out the interface structure, including the layout and menu screens of the educational game to be developed.

a. Learning Menu



Figure 2. Gameplay Flowchart

Figure 2 shows the flowchart diagram of the Learning Menu. The diagram illustrates the steps to open or start the learning menu. The first step begins when the user enters the application[25]. From the main menu, the user selects the "Learning" option, after which the learning page will be displayed.

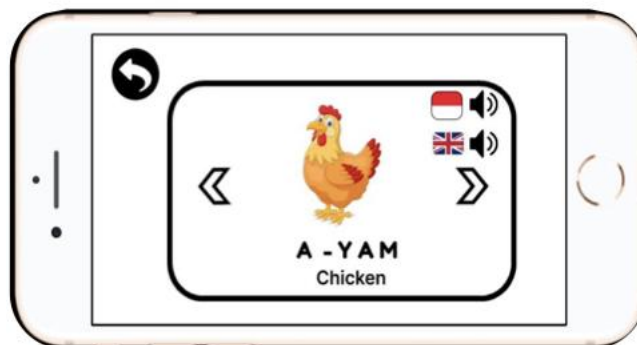


Figure 3. Gameplay Interface

Figure 3 shows the interface design of the "Learning" menu page. On this learning menu page, there are animated animal images, text displaying the animal names in both Indonesian and English, buttons with the Indonesian and American flags, next and previous buttons, as well as a back button.

b. Puzzle Menu

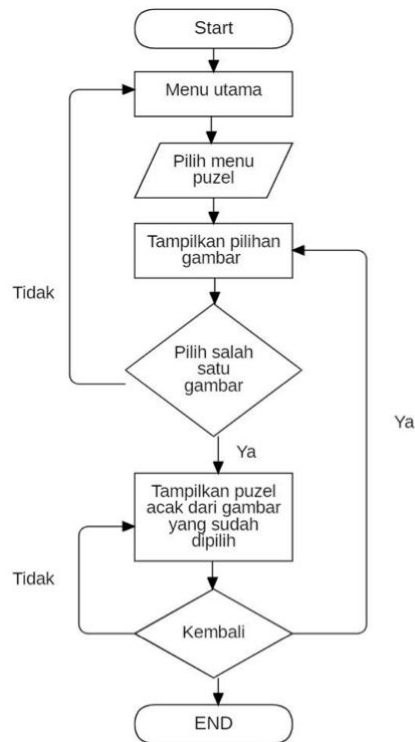


Figure 4. Puzzle Flowchart

Figure 4 shows the flowchart diagram of the “Puzzle” menu. The diagram illustrates the sequence of steps to start the “Puzzle” menu. The first step is to select the “Puzzle” option from the main menu, which will display a page showing several image choices. The user then selects one image, and the next page displays randomized puzzle pieces of the chosen image. If the user decides not to select an image, they can return to the main menu. If the user chooses to go back, the application will show the image selection page again; if not, the user will remain on the puzzle assembly page.

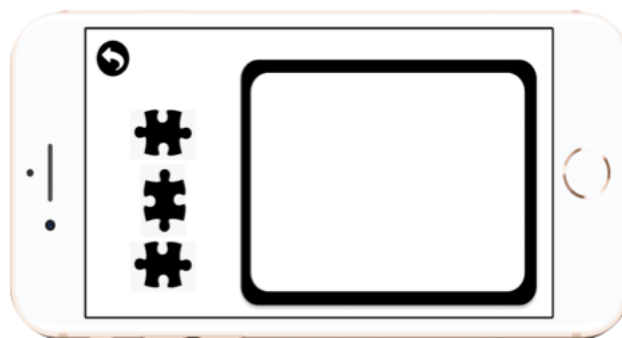


Figure 5. Puzzle Interface

Figure 5 shows the interface design of the “Puzzle” menu page. On this page, randomized puzzle pieces are located on the left panel, and on the right side there is a puzzle board where the pieces can be assembled.

3. Coloring Menu

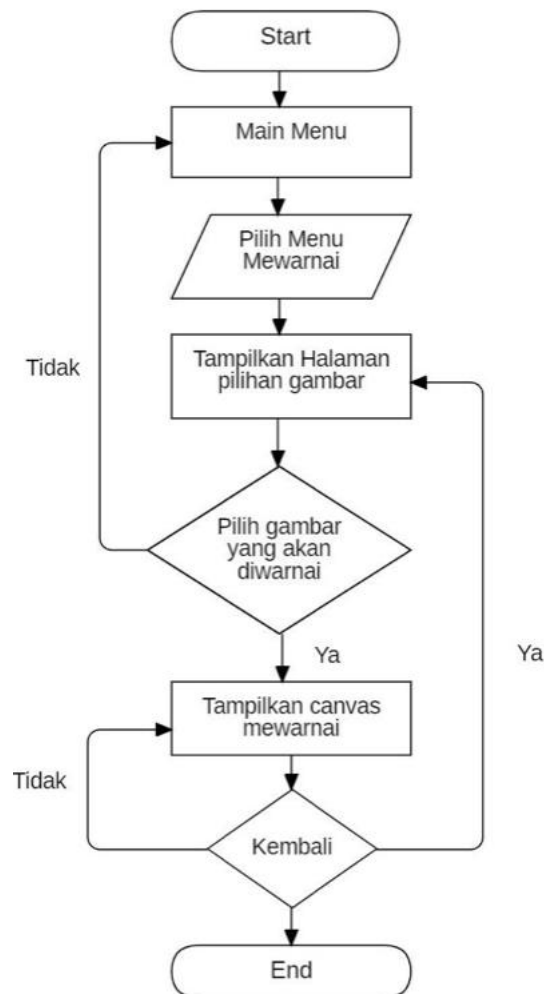


Figure 6. Coloring Flowchart

Figure 6 shows the flowchart diagram of the “Coloring” menu. The diagram illustrates the sequence of steps to start the “Coloring” menu. The first step is selecting the “Coloring” option from the main menu, which will display a page containing several image options. After selecting an image, the application will display a canvas with the chosen image for coloring. However, if the user does not want to select an image, they can return to the main menu. If the user chooses to go back, the app will return to the image selection page; otherwise, the user will remain on the coloring page.

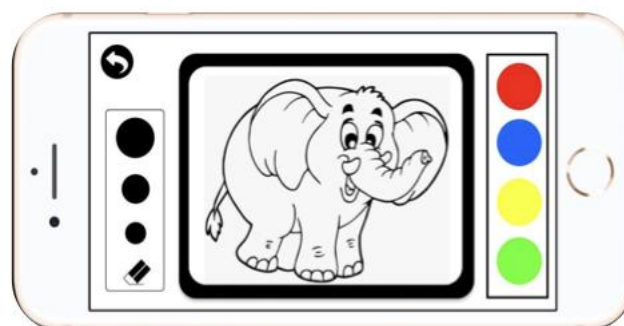


Figure 7. Coloring Interface

Figure 7 shows the interface design of the “Coloring” menu page. On this page, there is a drawing canvas for coloring, a color palette panel that functions as a color picker, and an eraser icon used to remove colors that have already been applied to the canvas.

4. Development

In the Development stage, the previously designed concepts begin to be realized into a tangible initial product of the educational game. The interface and coding are as follows:

Learning Menu



```
object", "objectClass": "Touch", "parameters": {"object": "home_btn"}}, {"actions": [{"id": "go-to-
layout", "objectClass":
"System", "parameters": {"layout": "mainmenu"}}, {"event": "block", "conditions": [{"id": "on-tap-object", "objectClass": "Touch",
"parameters": {"object": "AR"}}, {"actions": [{"id": "go-
tolayout", "objectClass": "System", "parameters": {"layout": "belajar_anjin
g"}}, {"event": "block", "conditions": [{"id": "on-
tapobject", "objectClass": "Touch", "parameters": {"object": "ALeft"}}, {"actions": [{"id": "go-to-
layout", "objectClass": "System",
"parameters": {"layout": "belajar_ular"}}, {"event": "block", "conditions": [{"id": "on-tap-
object", "objectClass": "Touch",
```

Figure 8. Learning Menu Interface and Coding

5. Puzzle Menu



```
{"eventType": "block", "conditions": [{"id": "on-drag-start",
"objectClass": "P_Kelinci2", "behaviorType": "DragDrop"}, {"actions": [{"id": "move-to-
top", "objectClass": "P_Kelinci2"}, {"id": "setsize", "objectClass": "P_Kelinci2", "parameters":
{"width": "300", "height": "300"}}, {"event": "block", "conditions": [{"id": "on-start-of-
layout", "objectClass": "System"}, {"actions": [{"id": "set-instvar-
value", "objectClass": "P_Kelinci2",
```

Figure 9. Puzzle Menu Interface and Coding

6. Coloring Menu



```
Type": "variable", "name": "warna", "type": "string", "initialValue": "merah
", "comment": "", "isStatic": false, "isConstant": false}, {"event": "blo
ck", "conditions": [{"id": "on-start-of-layout", "objectClass":
"System"}], "actions": [{"id": "set-animation-frame", "objectClass": "red", "parameters": {"frame-
```

```

number": "1"}}, {"id": "set-
animationframe", "objectClass": "brush60", "parameters": {"framenumber": "1"}}}] {"is-c3-
clipboard-data": true, "type": "events", "items":
[{"eventType": "block", "conditions": [{"id": "is-
touchingobject", "objectClass": "Touch", "parameters": {"object": "coloring_deer"
}}], "actions": [{"id": "set-position", "objectClass": "Sprite16",
"parameters": {"x": "Touch.X", "y": "Touch.Y"}}, {"children": [{"eventT
ype": "block", "conditions": [{"id": "compare-eventvar",

```

Figure 10. Coloring Menu Interface and Coding

7. Implementation

Table 1. Educational Game Implementation

No	Evaluator	Question							
		1	2	3	4	5	6	7	8
1.	Guru 1	5	4	5	5	5	5	5	5
2.	Guru 2	5	4	5	5	5	5	4	5
3.	Guru 3	5	4	5	5	5	5	5	4
4.	Guru 4	5	5	5	5	4	5	5	5
5.	Guru 5	5	5	5	5	5	5	5	5
Total score		25	22	25	25	24	25	24	24
Maximum total score		25	25	25	25	25	25	25	25
Presentase (%)		100	88	100	100	96	100	96	96
Average percentage (%)		97 %							
Criteria		Very Good							

Based on Table 1, it is known that to obtain the criteria results from the questionnaire assessment, several evaluation steps were carried out. The scores given by each teacher for each question were summed, then the total maximum score was divided by the obtained score and multiplied by 100% to get the percentage result. The total of all percentages was then divided by the number of questions, resulting in an average percentage score of 97%. Based on this average percentage score, it can be concluded that the feasibility and teacher response to the educational game application titled “Kids Animaledu” are categorized as very good and declared suitable for use as a learning media.

Discussion

The effectiveness evaluation of this educational game was conducted using both quantitative and qualitative methods to provide a comprehensive overview of the media’s impact on early childhood animal recognition learning. Quantitatively, pre-tests and post-tests consisting of animal images and simple questions tailored to kindergarten children’s comprehension levels were used. The pre-test results showed an average score of 5.1 out of 10, reflecting the children’s limited initial understanding of the material. After using the educational game during the trial period, the average post-test score significantly increased to 8.4 out of 10, representing a 65% improvement. This increase strongly indicates that

the game-based media effectively enhanced children's understanding of animal names and characteristics.

Additionally, qualitative evaluation was carried out through direct observation and teacher questionnaires. Observations revealed that the children showed high enthusiasm when using the game, responding actively and with curiosity. The teacher questionnaires supported these findings, with the media rated as very engaging, scoring an average of 4.6 on a 5-point scale. Beyond attractiveness, teachers also assessed that the educational game was highly suitable for the learning characteristics of early childhood, who require interactive visual and audio media, with a suitability score of 4.7. Furthermore, teachers stated that this media greatly assisted the learning process, scoring 4.8, as it facilitated independent learning and increased children's engagement in learning activities

CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of the research and development conducted, several conclusions can be drawn as follows: The Android-based educational game developed meets feasibility criteria in terms of content, appearance, and interactivity, based on validation results from content and media experts, with an average score above 85%. The use of this educational game has been proven to increase the effectiveness of animal recognition learning in early childhood. This is demonstrated by the improvement in students' evaluation results from pre-test to post-test, as well as positive responses from teachers and students towards the learning media used. The application accommodates the learning characteristics of early childhood, namely learning through play (learning by playing), and can serve as an alternative solution to overcome the limitations of conventional learning media that lack interactivity. In terms of implementation, this media is practical to use in the classroom because it is compatible with mobile devices commonly owned by schools or parents, and does not require an internet connection once downloaded.

Suggestions

Based on the research and development results, the researcher offers several recommendations aimed at various stakeholders as follows:

1. The use of technology-based learning media, such as this educational game, should begin to be integrated into classroom teaching and learning activities. Teachers can utilize this application as a supporting tool for delivering thematic materials, especially on topics related to living beings. Using digital media that aligns with the characteristics of early childhood can increase learning motivation while providing a more enjoyable and interactive learning experience.
2. This study has several limitations that need to be considered. These limitations include a relatively small number of respondents, the trial period being limited in duration, and the material coverage focusing only on animal recognition. Therefore, it is recommended that future researchers conduct application testing on a larger scale and for a longer implementation period to obtain a more representative overview of the effectiveness of the developed learning media. Furthermore, similar applications can be expanded to other essential early childhood learning themes such as color, numbers, letters, or shapes to enrich the variety of interactive learning media. Researchers are also encouraged to apply more comprehensive evaluation approaches, both quantitative and qualitative, to gain deeper insights into the impact of digital media use on the cognitive, social, and motor development aspects of early childhood.

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