Developing Educational Mobile Games to Train the Sensory Abilities of Preschool Children

Khairul[1*], Rian Farta Wijaya[2], Leni Marlina[3]

[123]Faculty of Computational Science and Digital Intelligence, Information Technology, Universitas Pembangunan Panca Budi, Indonesia
E-mail: [1*]khairul@dosen.pancabudi.ac.id, [2]rianfartawijaya@dosen.pancabudi.ac.id, [3]lenimarlina@dosen.pancabudi.ac.id
*E-mail Corresponding Author: khairul@dosen.pancabudi.ac.id

Abstract

This study aims to develop an educational mobile game that can train the sensory abilities of early childhood (PAUD). The game developed carries the concept of puzzles and guessing pictures specifically designed to improve children's visual sensory abilities, fine motor skills, and visual perception. In developing this game, a Research and Development (R&D) approach was used with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The trial was conducted on groups of PAUD children at several educational institutions in Medan, with direct observation of children's sensory development while using the game. The results showed that this mobile game was effective in improving children's sensory abilities, with positive feedback from children and teachers regarding the ease of use and the level of children's involvement during the game. This game can be used as an alternative learning medium that is fun and educational for early childhood.

Keywords: Game Development, Mobile Education, Sensory Abilities, Early Childhood Education

I. INTRODUCTION

The introduction The rapid advancement of technology has brought significant changes to various sectors, including education. One of the innovations that has emerged is the use of educational games, which offer an engaging and interactive approach to teaching early childhood education (PAUD). The use of educational games based on technology is expected to stimulate cognitive, motor, and sensory development in children(Mardhotillah, 2022).

Early childhood, particularly in PAUD settings, is a crucial phase in the development of sensory abilities, such as recognizing colors, shapes, and improving hand-eye coordination(Harahap, 2023). Children in this age group need appropriate stimulation to enhance their fine motor skills and visual perception, which can be achieved through engaging learning media that are aligned with their developmental stages(Motimona & Maryatun, 2023).

Puzzle games and picture guessing games are effective types of games for enhancing children's sensory skills. Puzzle games help children recognize shapes and patterns and introduce them to the concept of image cohesion(Aini et al., 2019) .Meanwhile, picture guessing games can train their visual memory and perception, which are essential for cognitive development(Mandala et al., 2022).Both types of games can effectively improve visual skills, memory, and fine motor coordination in children(Harmila et al., 2023).

Furthermore, the use of mobile technology in education offers numerous advantages, such as easy access and active engagement from children(Komputer et al., 2025). Mobile-based games allow children to learn independently outside the classroom, with supervision from teachers or parents(Apriani et al., 2024). This is in line with research showing that technology-based games can enhance intrinsic motivation in learning(Firman Alamsyah et al., 2024) .Mobile games also provide opportunities for children to develop learning resilience through direct experimentation, allowing them to repeat games based on their progress(Wahyuni, 2021).

The goal of this study is to develop an educational mobile game that can stimulate sensory skills in PAUD children, using puzzle games and picture guessing games as methods designed to enhance visual sensory and fine motor skills(Apriliani et al., 2024). The development of this game follows the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), a systematic approach to creating and evaluating learning media(Agustina, 2019).

II. RESEARCH METHODOLOGY

This study used a Research and Development (R&D) approach to develop an educational mobile game aimed at developing sensory skills in preschool children through puzzles and guessing games. This approach was chosen because it allows not only testing theory but also developing a product that can

be directly applied in early childhood learning. The game was developed using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model, an instructional development model that has been proven effective in designing and evaluating learning media(Maulana et al., 2023).

Figure 1. Research Methodology

a. Analysis (Needs Analysis)

This stage involves analyzing the sensory learning needs for PAUD children through interviews with PAUD teachers and a review of the existing curriculum. The identified needs include fine motor skills, visual perception, and pattern recognition that are appropriate for the developmental stage of PAUD children. In addition, an analysis of existing educational games is also conducted to identify their strengths and weaknesses(Saputra et al., 2023).

b. Design

In the design phase, the game concept is developed by considering factors such as:

Type of game: puzzle and picture guessing games.

Game features: interactive elements that can train hand-eye coordination and shape and color recognition.

User Interface (UI): child-friendly design, with large icons, contrasting colors, and easy-to-understand navigation.

Game flow: establishing game levels with different difficulty levels to accommodate the developmental capabilities of PAUD children.

c. Development

At this stage, the game is developed using game development software such as Unity or Android Studio, depending on the chosen platform. During development, particular attention is given to the user experience (UX) to ensure that the game is easy for young children to use. Additionally, the game development also involves creating visual and audio assets that are suitable for the characteristics of PAUD children.

d. Implementation

After the game is developed, a limited trial is conducted with a small group of PAUD children in selected educational institutions. The trial aims to observe the children's responses to the game, monitor their interaction with the game, and collect data on the ease of use and the impact of the game on children's sensory abilities.

e. Evaluation

The evaluation is conducted in two stages:

Formative evaluation: conducted during the design and development phases, through feedback from experts and limited trials.

Summative evaluation: conducted after the full trial with PAUD children, through observations of their sensory development and analysis of questionnaire results from teachers and parents regarding the game's effectiveness.

III. RESULTS AND DISCUSSION

3.1 Story Board

The storyboard will show the sequence of the application's interface, including the multimedia elements used. By creating a storyboard, researchers can plan user flows, interactions, and visual elements that will enhance the user experience of the Dinosaur Puzzle Game application.
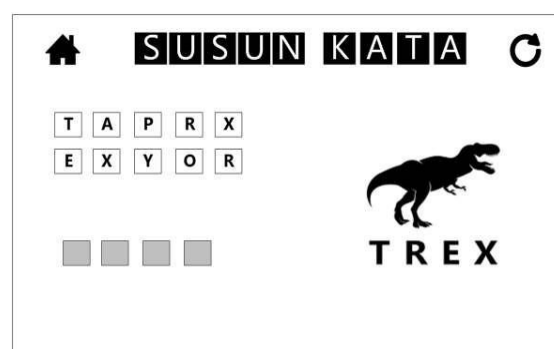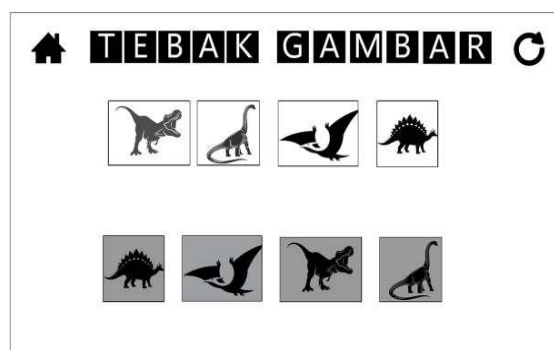

Figure 2. Word Arrangement Storyboard.

Figure 3. Guess the Picture Storyboard.

Figure 4. Storyboard Jigsaw Puzzle.

3.2 Use Case Diagram

The use case diagram illustrates system activity from the user's perspective, helping to understand the functional requirements of the game application. The following is a use case diagram for the Game application.
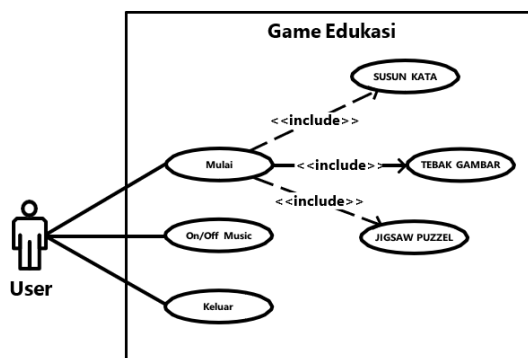

Figure 5. Use Case Diagram of Education Game.

3.3 Use Case Diagram

The activity diagram of the educational game application can be seen in the following image:
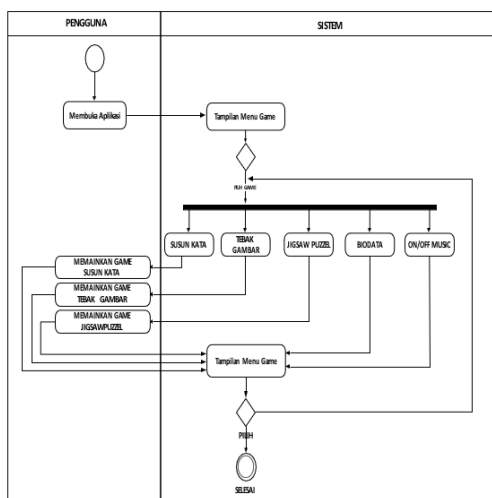

Figure 6. Activity Diagram of Education Game.

3.4 Class Diagram

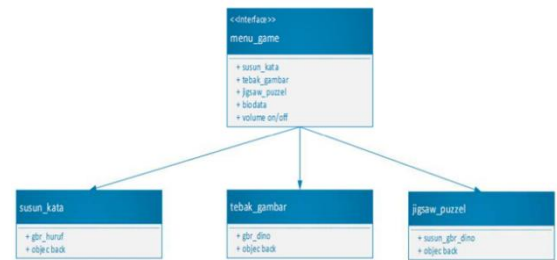The class diagram for the educational game application can be seen in the following image :

Figure 7. Class Diagram of Education Game.

3.5 The Game Menu Interface

The game menu interface is the display that appears when the application is first launched. This display contains five buttons: Music, Word Sort, Guess the Picture, and Jigsaw Puzzle. Users will be directed to select the type of game they wish to play.

a. Main Menu Interface

Figure 8. Main Menu Interface.

b. Word Arrangement Interface View.

The Word Puzzle Game interface displays a playable page for users, where they are guided to correctly and appropriately construct words. Users are expected to remember and recognize the names of the dinosaurs. The word puzzle game interface is shown in the following image:

Figure 9. Word Arrangement Interface View.

c. Guess the Picture Interface.

This app also offers a second game option, Guess the Picture, where users must correctly place the image. The game involves moving the image into the box that matches its shadow. For a clearer overview of the Guess the Picture interface, see the image below :

Figure 10. Guess the Picture Interface.

d. Jigsaw Puzzle Interface.
The Jigsaw Puzzle game is the final game available in this application, where users are expected to arrange image pieces to form a complete picture. To play, move the image pieces into the provided boxes according to their image's shadow. The Jigsaw Puzzle interface can be seen in the following image:

Figure 11. Jigsaw Puzzle Interface.

3.6 The Black-box Test Results

Black-box testing of the Android-based Dinosaur Puzzle Game using Construct 2 was conducted on each test item to determine whether

the game's functions were working properly. Based on the testing, the game performed well, with the output meeting expectations. The test results are shown in the following table:

A. Loading Page: Can display the login process page to the application
B. Main Menu: It displays the Game Menu page, which contains five buttons: Music on/off, Biodata, Word Sort, Guess the Picture, and Jigsaw Puzzle.
C. Word Arrangement Game : It displays the Word Stacks game page, which features letter tiles, empty tiles, and dinosaur images,

with music effects. It also features a trophy effect and a next button to continue the game.
D. Picture Guess Game : It displays the Guess the Picture Game page, which features several dinosaur images in boxes, dinosaur shadow boxes, and music effects. It displays trophy effects and a next button to continue the game.
E. Jigsaw Puzzle Game : It displays the Jigsaw Puzzle Game page, which contains several random image pieces, shadow boxes for arranging the random images, and music effects. It features a trophy effect and a next button to continue the game.

3.7 User Respondent Test Results
The user respondent test was conducted by distributing a questionnaire to 12 PAUD students aged 3-5 years old. The questionnaire consisted of seven questions. The summary of the scores can be seen in the following table.

Table 1. User Respondent Test Results

No.	Name	Question						
		Q1	Q2	Q3	Q4	Q5	Q6	Q7
1	Runaco Aulia	3	4	3	4	3	4	3
2	Rahma	4	3	4	4	3	3	4
3	Sholeha	3	4	3	4	4	3	4
4	Nia Jailania Farah	3	4	4	3	4	4	3
5	Salsabilla Uwais	4	3	4	4	3	3	4
6	Arthoriq	3	3	3	3	4	4	3
7	El Vano	4	3	3	4	3	4	4
8	Kinanti	4	3	4	3	3	4	4
9	Clara	3	4	3	3	3	4	3
10	Arta	4	3	4	3	4	4	4
11	Arsyila	3	4	3	3	3	4	3
12	Reski	3	4	3	4	4	3	4
	Amount	**41**	**42**	**41**	**42**	**41**	**44**	**43**

Table 2. Respondent Questionnaire Score

No	Question	Number of Items
1	The game's visuals (design, colors, and dinosaur graphics) are engaging and appropriate for children.	41
2	The game app is easy to download and install on Android devices.	42

No		Score
3	The puzzle difficulty level (number of pieces, image complexity) is appropriate for the target player's age.	41
4	The touch controls (drag and drop, tap) are responsive and accurate.	42
5	The in-game music and sound effects are appropriate and non-intrusive.	41
6	The game helps improve children's cognitive abilities (problem solving, logic, memory).	44
7	This game app is safe for use by children (no inappropriate content).	43
	Total	**294**

Table 3. Criteria Classification

No	Presentation	Criteria
1	75% – 100%	Very Eligible
2	50% – 75%	Eligible
3	25% – 50%	Quite Eligible
4	1% – 25%	Less Eligible

Table 4. Respondent Questionnaire Score Results

No	Number of Respondents	Instrument	Ideal Score (n)	Total Score (f)	Presentation	Criteria
1	12	7	300	294	98.0%	Sangat Layak

Formula :

$P = (f/n) \times 100\%$

$P = (294/300) \times 100\%$

$\quad = 0{,}98 \times 100\%$

$\quad = 98{,}0\ \%$

Information:

P : Presentation

f : Total score

n : Ideal Score

Based on the results of calculations and research generated from all respondents, the Android-based educational game application received a score of 294 on 7 questions conducted by distributing 12 questionnaires to PAUD students, resulting in very suitable criteria with a percentage of 98.0%.

IV. CONCLUSION

This study successfully developed an educational mobile game designed to enhance the sensory skills of PAUD children through interactive puzzle and picture guessing games. By using the ADDIE model for the game development process, this research demonstrated the importance of incorporating technology-based learning tools that are engaging and suitable for the developmental needs of young children. The game was designed to stimulate visual perception, fine motor skills, and hand-eye coordination, all of which are critical during the early childhood developmental stage. The evaluation results indicated that the game was well-received by both children and teachers, with positive feedback regarding the game's ease of use and its ability to engage children. The game provided an effective and enjoyable medium for sensory skill development, showing that mobile games can be an effective educational tool in early childhood education settings. Moreover, the game's ability to provide an interactive learning experience aligns with current trends in educational technology, where digital tools can complement traditional methods and foster active learning. The findings from this study suggest that mobile educational games can be a valuable resource for stimulating sensory development and enhancing cognitive skills among PAUD children. In conclusion, the developed mobile game shows promise as an innovative learning tool for PAUD classrooms. Future research could explore further refinements to the game and its integration into broader educational curricula. Additionally, future studies could examine the long-term effects of mobile game-based learning on children's overall development.

V. RECOMMENDATIONS

Based on the findings of this study, several recommendations can be made for future research and practical applications in early childhood education:

1. Integration of Mobile Games in PAUD Curricula
It is recommended that educational institutions consider integrating mobile games, particularly those designed to enhance sensory skills, into their PAUD curricula. Mobile games like the one developed in this

study can complement traditional teaching methods, offering an interactive and engaging learning experience that stimulates various developmental areas such as visual perception, fine motor skills, and cognitive abilities. Future studies could explore the long-term impact of integrating such games into daily learning routines for children.

2. Expansion of Game Features
While the current game focused on visual and motoric sensory skills, future versions could include additional features targeting other sensory areas such as auditory and tactile skills. Incorporating sound-based activities or touch-based interactions (e.g., haptic feedback) would make the game more comprehensive in addressing the full spectrum of sensory development. Future research should explore how multisensory experiences can be effectively integrated into mobile games for young children.

3. Customization and Adaptability
To ensure the game meets the developmental needs of a diverse group of children, it is recommended to include adaptive difficulty levels that can be adjusted according to the child's abilities. Incorporating real-time assessments to tailor the game's challenges to each child's progress could further enhance the learning experience. Such adaptive learning features would ensure that the game remains engaging and effective at different developmental stages.

4. Further Evaluation with Larger Samples
The current study involved a limited sample of PAUD children. Future research should expand the evaluation to include a larger and more diverse group of children from various backgrounds and educational settings. This would help in understanding the generalizability of the game's effectiveness across different contexts and populations. Longitudinal studies could also explore the long-term impact of using mobile educational games on children's sensory and cognitive development.

5. Collaboration with Educators and Parents
It is recommended that future iterations of the game involve close collaboration with teachers and parents to ensure that the game is aligned with educational goals and can be effectively used in both classroom and home settings. Teachers could also provide valuable insights into the pedagogical strategies that best complement mobile game-based learning. Parental involvement is crucial in ensuring that the game is used effectively at home and that children benefit from guided play sessions.

6. Exploration of Cross-Cultural Applicability
Given the global use of mobile technologies, it would be valuable to investigate how the educational game can be adapted and applied in different cultural contexts. Exploring the cross-cultural applicability of

the game could help in understanding how it can be customized to meet the needs of children in various regions, particularly in non-Western educational environments where mobile learning is still emerging.

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