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THE DEVELOPMENT OF PUZZLE GAMES FOR EARLY CHILDHOOD BASED ON THE BANTEN LOCAL CULTURE

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Abstract

Developing a digital puzzle game model is a learning innovation for early childhood cognitive development. The current research purpose was to develop a digital games puzzle based on Banten culture for early childhood; The method applied was the research and development of ADDIE's model with the 30 children as samples. The results revealed five puzzle game objects and levels 1-3. The weakness of this puzzle game was that there was no animation, while the advantages of this puzzle game were that it was easy to be used by children; it could be used via Android and laptops, the game menus were easy to understand, it has attractive design and game background, and it was provided with game tutorials. The material expert test results were 88%, which was very feasible; the media expert test results were 85%, which was also very feasible; and the field test results were 97%, excellent. This research concluded that the data processing using paired t-tests obtained a sig value of 0.000, less than 0.05 (0.000 <0.05). Then it could be obtained the decision to reject Ho. It means that there were differences in children learning outcomes before and after using puzzle games.

Keywords: *Puzzle Games; Early Childhood; Banten Local Culture.*

A. Introduction

The COVID-19 pandemic has changed face-to-face learning into virtual face-to-face learning from early childhood education to higher education. Virtual face-to-face learning through the use of social media platforms and multimedia learning (Hirokazu Yoshikawa, Alice J. Wuermli, Pia Rebello Britto, Benard Dreyer, James F. Leckman, Stephen J. Lye, Liliana Angelica Ponguta, Linda M. Richter, 2020; Liromaria Mariade Amorim, Jucier Gonçalves Júnior, Modesto Leite Rolim Neto, Saulo Araújo Teixeira, 2022; Melanie Brooks, Edwin Creely, 2022; Michelle Neuman, 2022; Nicholaus Reuge and Robert Jenkins, et., 2021; Selvi., 2022). Learning games aim to facilitate early childhood learning due to the impact of changing learning during the covid-19 pandemic. Before the covid-19 pandemic, children played and studied at school with teachers and peers. During the covid-19 pandemic, children learn from home with their parents. This condition causes the transition of traditional games to digital games. Digital games are one of the solutions for early childhood learning media. Parents and teachers must be able to choose digital learning media appropriate for children's development.

Gamification is one of the learning media that can be used in early childhood learning (Aziz, 2019; Destiranti, 2016; Fox, 2015; Grieshaber, 2016; Luis de-Marcos, Eva García-López, 2017; Ng, 2021; Rula Al-Azawi, Fatma Al-Faliti, 2016; S.Bhat, 2022; Tongtong Kang & Minjin Kim, 2021). Banten province has five ancient mosques: the Kasuyatan mosque, the Daarul Falah mosque, the Tanara or Syech Nawawi Al Bantani mosque, the Banten Lama mosque, and the Kenari mosque. The photos of the ancient mosque are designed to be a puzzle game application. This application is designed with the concept of gamification.

Gamification of concept is the application of game design elements and game principles in non-game contexts. It can also be designed as a set of activities that include problem-solving processes by using or playing the characteristics of game elements. Gamification of the education concept is a strategy for increasing engagement by incorporating game elements into an educational environment (Dicheva, 2017). The principles of gamification for

learning engagement are: it is about a story, let players know how they are doing, reward players often, aesthetics matter, gotta catch them all, and gradually add complexity to keep activities or learning process enjoyable. Puzzle games are digital games designed for educational enrichment, using interactive multimedia technology (Widiastuti, 2012). The criteria for puzzle games are: the overall value of a game is centered on the design and length of the game duration, the timer feature can be used and accessed easily by users, and the accuracy of the design of this application must be by the game model at this stage. Planning, the suitability of the application containing the features and menus required by the user to assist the user's understanding in using the application, the relevance of the application containing content for early childhood so that the interface design displays cheerful colors, the objectivity of the application presents animations and sound effects indicating success or failure.

Based on the literature review, the stages of making interactive puzzle games for the puzzle design of ancient mosques in Banten are as follows: data collection of image objects and other supporting materials, functional and non-functional problem analysis, modeling and design, making animation, making coding, testing, evaluation. The puzzle game content is designed through serialization, classification, number construction, and time and place activities. Computer-based learning has provided emotional experiences, expression, happiness, satisfaction, fear, and the development of early childhood imagination.

The aims of the research develop puzzle games with the theme of local wisdom of Banten, Indonesia culture: (1) how to design the development of early childhood puzzle games based on local culture?, (2) is the application of puzzle games for early childhood based on local culture can increase the cognitive development of children aged 5-6 years? The novelty of this research is that the researcher analyzes the research results, including aspects of goals, learning, skills, achievement, challenge, reward, competition, user, and engagement.

B. Method

The sample of this study was 30 early childhood children. This study used a combination of methods, namely ADDIE (H. Sutopo et al., 2019). Research and development ADDIE's model (Analyze, Design, Develop, Implement, Evaluate) design uses the following criteria (1) Analyze. The aims of this paper are defined for drug impact information, information content, audience, and infrastructure; (2) Design. The design of learning content, the users, and the primary users are determined at this stage; (3) Develop. In this stage, product development uses the Multimedia Development Life Cycle according to Luther (Cheung L., 2006), which consists of six stages: concept, Design, Obtaining Content Material, Assembly, Testing, and Distribution at the Design stage, storyboards, and navigation structures are made. Then in the Assembly stage, all applications were built using Adobe Animate with Action Script 3 programming.

The results of this game application are in the APK file format that can be run on mobile devices. In the fourth stage of ADDIE, namely, Implement, testing is carried out by checking whether the application made meets the stated goals. Game application testing is carried out in three stages: (a) In The first trial, the system is tested to improve all application functions to run correctly. After functional testing, the application must run on various mobile devices; (b) The second trial, the test is carried out by colleagues and experts in several related fields; (c) The third trial is done with early childhood respondents, teachers, and parents to find out whether the application is feasible to use. The fifth stage of ADDIE, namely, Evaluate, is carried out after its widespread use in the community. This research was carried out until the fourth stage of ADDIE, namely, Implement.

The learning material instrument is based on the analysis of cognitive learning needs for early childhood 5-6 years old (*Kurikulum PAUD 2013*, 2014; Piaget, 2001; Vygotsky, 1978). They adapted learning media instruments based on a literature analysis review of multimedia learning (Edgar Dale, 1969; Heinich, R. Molenda, M and Russle, 1990; S. Brunner, 1977). Researchers collaborated with PAUD Doctors to test the feasibility of cognitive learning materials for children aged 5-6 years. The validator of the

puzzle game material is the Early Childhood Doctor. The researcher also collaborates with the Doctor of Educational Technology to test the feasibility of learning media. The validator of learning media is the Doctor of Educational Technology. Data collection techniques used questionnaires and observations (Creswell, 2014). The data analysis technique is descriptive analysis (Creswell, 2018). The evaluation interval for validating the puzzle games application is as follows.

Table 1. Program Validation Value Interval (Creswell, 2018)

Value Interval	Category
R = 5	Very Valid
4<R<5	Valid
3<R<4	Quite Valid
2<R<3	Not Valid
1<R<2	Invalid

The results of the field trial use the following assessment intervals.

Table 2. Assessment of Field Test Results (Creswell, 2018)

Assessment Criteria	Scale	Score	Percentage
Very Good	5	46-65	81-100%
Good	4	32-45	61-80%
Enough	3	28-31	41-60%
Not Enough	2	14-27	21-40%
Very Less	1	1-13	1-20%

The puzzle game design stages consist of the main menu display, the gameplay display, and the final result display. The puzzle games comprise features, gameplay, interface, rules, and level design. This component is designed aiming to create an exciting experience. The puzzle game application is another menu display, the game puzzle play display, and the final result display.

Main menu display

The main menu displays the system after the user logs in. Then the user immediately starts the puzzle game. The main menu display has two images equipped with a background.

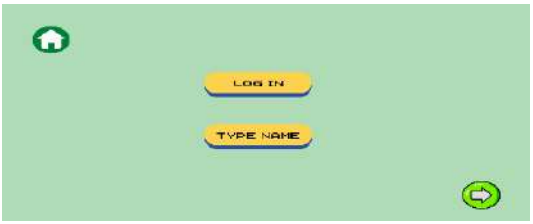

Figure 1. Main menu, login

Figure 2. Home Choice of Puzzle Game

The game puzzle play display has ten pictures

Figure 3. Puzzle game Kasuyatan Mosque

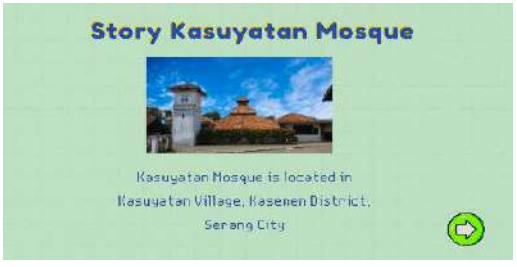

Figure 4. Story of Kasuyatan Mosque

Figure 5. Puzzle game Daarul Falah

Figure 6. Story of Daarul Falah Mosque

Figure 7. Puzzle game Banten Lama Mosque

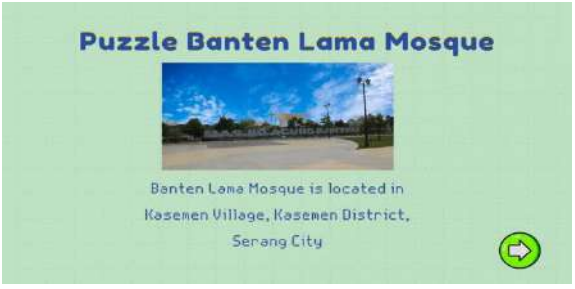

Figure 8. Story of Banten Lama Mosque

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Figure 9. Puzzle game of Tanara Mosque

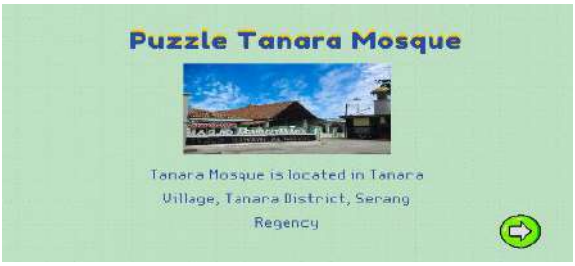

Figure 10. Story of Tanara Mosque

Figure 11. Puzzle game of Kenari Mosque

Figure 12. Story of Kenari Mosque

The final result display has two pictures

Figure 13. The display explains that the user has completed the game. If successful, press the hold button or finish

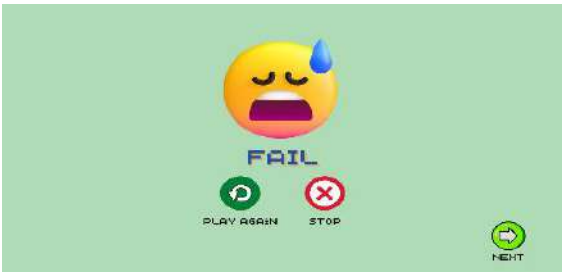

Figure 14. It shows that the user has completed the game. If it fails,the button can be pressed and held

C. Result and Discussion

The following shows research results and discussion based on research questions. The research question was to design the development of early childhood puzzle games based on Banten culture. Applying early childhood puzzle games based on Banten culture is interesting for improving children's cognitive development aged 5-6.

1. Result

The design stages of the ADDIE research model are designing tutorials to get good products so that the learning process becomes more effective and efficient. The learning design employs the ADDIE model: (1) Analyze. At the analysis stage, instrument validation has been carried out by material experts, media experts, and users. The user test has been targeted, namely early childhood 5-6 years, characteristics of children's cognitive development, number of children, location of children, age group, attitudes,

learning environment support, and successful use of puzzle games applications (2) Design. At the Design stage, storyboards and navigation structures are made, then at the Assembly stage, all applications are built using Adobe Animate with ActionScript 3 programming. The results of this game application in the APK file format can be run on mobile devices, (3) Develop. At this stage, content development includes the development of cognitive concepts and theories for early childhood 5-6 years, activities, and practices. Media development includes the development of multimedia concepts and theories of learning, auditory, visual, kinesthetic, and practical. Developing puzzle game tutorials involves creating titles, formats, sequences, quality, clarity, accuracy, and consistency. (4) Implement testing checks whether the application is for the specified purpose.

Game application testing is carried out in three stages: (a) In The first trial, the system is tested to improve all application functions to run well. After functional testing, the app should run on various mobile devices; (b) The second trial, the tests were carried out by colleagues and experts in several related fields; (c) The third trial with early childhood respondents to find out whether the application is enjoyable to use, (5) Evaluate. At this stage, the evaluation has met the criteria for perception, early childhood cognitive learning, and performance puzzle games carried out after their widespread use in society. All ADDIE stages have been implemented in this research. Here are the results.

Table 3. Field test results

No.	Indicator	Respondent Soce ∑	Average ∑ Score	Percentage
1.	Children can log in and log out Edugame puzzle	150	5	100%
2.	Children can concentrate	149	4,9	99%
3.	Children can solve simple problems	150	5	100%
4.	Children can train hand and eye coordination to compose the ancient mosque puzzle game of Banten	150	5	100%

No.	Indicator	Respondent Soce ∑	Average ∑ Score	Percentage
5.	Children can practice patience	149	4,9	99%
6.	Children can name puzzle pieces 1-20	150	5	100%
7.	The child can name and show the letters a-z	147	4,9	99%
8.	Children can arrange the pieces of the picture into one picture of the mosque	150	5	100%
9.	Children can arrange the complexity of the puzzle pieces of 6, 10, 20 pieces	150	5	100%
10.	Children can distinguish the name of the mosque in the puzzle picture	147	4,9	99%
11.	Children can complete the edugame puzzle game without the help of others	150	5	100%
12.	Children are motivated to complete the puzzle game on time	144	4,8	96%
13.	Children can answer game puzzle questions given by the teacher	150	5	100%

Based on the user test of early childhood games, the results are 144-150 = 97%, meaning that game media is very suitable for children 5-6 years.

Table 4. Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretes	30	42.00	56.00	46.0333	2.89451
Postes	30	62.00	65.00	64.5000	.86103
Valid N (listwise)	30				

Table 5. Paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretes	46.0333	30	2.89451	.52846
	Posttest	64.5000	30	.86103	.15720

Table 6. Paired samples test

			Pair 1
			Pretes - Postes
Paired Differences	Mean		-18.46667
	Std. Deviation		2.94470
	Std. Error Mean		.53763
	95% Confidence Interval of the Difference	Lower	-19.56624
		Upper	-17.36710
t			-34.349
df			29
Sig. (2-tailed)			.000

2. Discussion

Analysis of the design model for developing early childhood puzzle games based on Banten culture used the ADDIE design. This design underwent two refinements. Materials experts and media experts validated the prototypes. Improvements from media experts provided revisions to image quality and color proportions. Material experts provided revisions to reduce the narrative in the puzzle edugame and change the font and typeface to make it easier for children to read. Furthermore, the prototype of 1 puzzle game was tested individually on ten children.

Based on the results of experimental observations, researchers made improvements. Namely, researchers revised the number of puzzle pieces and the duration of time. The initial number of puzzle pieces for each picture was 1-3 levels. The revised five images have varying levels: Level 1 has five pieces, level 2 has ten, and Level 3 has 20 pieces. Prototype 2 was tested on 30 children; researchers revised the volume of background music in puzzle games. In the final stage of conducting a field

test on 30 children, the results were 144-150 = 97%. It means that puzzle game media is exciting to use for improving the cognitive development of early childhood 5-6 years.

The analysis of the application of early childhood puzzle games based on Banten culture is very interesting for improving the cognitive development of children aged 5-6 years. The analysis includes the analysis aspects of goals, learning, skills, challenges, prizes, competitions, and user interest or user engagement (Baiq Olatul Aini, Khaerunnisa Cantika Ayu, 2019; Emily C. Hanno, Madelyn Gerdner, Stephanie M. Jones, 2022; Isharwati, 2015; Muhammad Rais & Muhammad Riska, 2018). The goal (goal) of puzzle game design is the cognitive development of children aged 5-6 years in the 2013 PAUD curriculum: children can mention the sequence puzzle pieces 1-20 and arrange pieces of pictures into one mosque object, and children can solve problems.

Learning in the application of puzzle games can develop aspects of children's cognitive development, namely solving problems, counting 1-20, and recognizing colors and numbers (Ahmad Sabri, 2020; Berk, 1989; S.Feldman, 1990), aspects of the development of religious values, namely religious characters teach prayers in mosques, recognize the spread of religion in Banten, religious figures Islam in Banten, architectural design of ancient mosques in Banten; aspects of moral development, namely children can implement local cultural values, learn concentration, patience, solve problems, and work on time (Alison M-C.Li, Janet S. Gaffney, Adrienne N. Sansom, 2021; Hari Naredi, Jumardi, Lelly Qodariah, 2020; Nisa, 2021).

Aspects of social development that children playing games must be happy (Hong, 2020) teach tolerance of religious life because next to the Great Mosque of Banten stands a Pagoda to worship Buddhists. Aspects of emotional development, hard work, creativity, independence, and curiosity). Knowing; aspects of physical development of fine motoric children can coordinate eyes and hands to arrange puzzles according to objects and timers in the application; aspects of music development, in which children can sing background songs in the game application. Skills (skills); where children can type features in applications such as login, open,

closed, play again, and use general control Q to play puzzle games to completion.

The challenges of this puzzle game are five objects from ancient mosques in Banten, the number of puzzle pieces is level 1-3, and the timer is on the application. There are three levels; all children can use the application up to level three with excellent results. If the child can arrange the puzzle on time and according to the object's shape, the prize is in the form of good job writing, a reward if they lose or exceed the timer, they try again. Competition (competition) in this application is when children compete with themselves and compete with peers. Competition with oneself, namely, the child must be able to put the puzzle together before the application timer finishes. Competition with peers, where children try as fast as possible to complete five puzzle objects in levels 1-3. Interest (user engagement) and cognitive presence of children can solve edugame puzzle problems; the affective presence of children can answer teacher questions well; social presence is that children can compete with peers (Randy Garrison, 2016).

The teacher acts as a facilitator, observer, motivator, and playmate. As a facilitator, the teacher can facilitate children to use puzzle game applications actively and dynamically. Observer teachers can observe children using the application, how long the child does a game, the difficulties the child faces, and the child's concentration. As a motivator, the teacher can drive children to explore, find, and arrange puzzle pieces correctly. The teacher, as a friend or co-player, can place himself as a good friend so that the learning situation through playing is fun and happy.

The limitations of this puzzle game are on the elements of the user population, edugame wisdom theme, application level, and application features. The population of puzzle game users is still limited to respondents for individual trials, limited trials, and field trials in Serang City, Banten Province, Indonesia. The theme of local wisdom in Banten is that there is typical food, Banten batik, Baduy tribe, traditional arts debus, and traditional houses. Features in the application must continue to be updated according to the development of mobile Android. The advantages of this puzzle game are that it can be used

through various types of Android and laptops. Weak animation and total scores in puzzle games still need to be created.

D. Conclusion

Based on the data processing results using paired t-test, the conclusion was that a sig value of 0.000 was less than 0.05 (0.000 <0.05). Then it can be obtained the decision to reject Ho. It means that there are differences in children learning outcomes before and after using puzzle games. The development of the ancient mosques puzzle game model can be used to improve the cognitive development of early childhood. Based on the material expert test and media expert test, the results show that the ancient Banten mosque puzzle games are very feasible because they meet the criteria for being usable and accessible, accurate, relevant to early childhood cognitive learning outcomes, child age appropriateness, objectivity, and feedback on success or failure scores. Test results from application users are 97% on perfect criteria. The application was user-friendly.

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