



Developing Digital Learning Media to Promote Early Children's Cognitive Development

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Abstract. This research aims to develop a digital learning media called "Who Game" to promote children's cognitive development aged 4-5 years. This research and development (R&D) use the Borg and Gall model, which consists of 9 steps; information collecting, planning, developing a preliminary form of product, preliminary field testing, main product revision, main field testing, operational product revision, operational field testing, final product revision, dissemination and implementation. The feasibility of the product is based on the validation of media experts, material experts, and linguists. Initial field testing to 3 children, main field testing to 6 children, and group testing to 15 children in Langsa. The results showed that "Who Game" learning media was feasible to become a fun digital media and can improve early childhood cognitive abilities. In the learning media of "Who Game", children can recognize objects based on function, objects as games, simple concepts in everyday life, and activity patterns. Therefore, the digital media "Who Games" can be an alternative technology-based learning media that can improve early childhood cognitive abilities. Next, the researcher can further investigate research on implementing this digital media in early childhood institutions.

Keywords: Digital Learning Media, Technology for Children, Cognitive Abilities, Early Childhood First Section

1 Introduction

In recent years, technology use is becoming popular in early childhood education. Technology has emerged in the educational domain as a tool to make learning more efficient [1,2], exciting dan interesting [3]. The National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center (FRC) for Early Learning and Children's Media at Saint Vincent College developed a joint position statement on technology and interactive media as tools in early childhood programs serving children from birth through age 8 [4]. In line with this, preparation for digital literacy is facilitated as many technology standards embrace similar goals of traditional non-digital learning activities. National Educational Technology Standards and Performance Indicators include creativity and innovation; communication and collab-

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oration; critical thinking, problem-solving, and decision-making; research and information fluency; digital citizenship, and technology operations and concepts [5].

Early childhood educators are exploring opportunities to integrate technology and interactive media into the current curriculum [6]. A wide range of educational apps allows early childhood teachers to overcome technology barriers [7] and design more hands-on, child-centered, collaborative activities for young students [8]. Therefore, early childhood teachers need to know how to use digital media to support students' learning and to help them develop skills they will need for the future [9].

One important aspect of early childhood that must be optimally developed is cognitive ability. Cognitive is the ability to think more complexly and critically and do reasoning and problem-solving. Cognitive development means how children think, explore and figure things out. It is the development of knowledge, skills, problem solving and dispositions that help children think about and understand the world around them. Cognitive abilities will develop gradually, in line with physical development and the nerves in the center of the nervous system (Haryani and Sari 2021). Piaget argued that children's cognitive development occurs in four major stages and called them (1) sensorimotor intelligence, (2) preoperational thinking, (3) concrete operational thinking, and (4) formal operational thinking [10]. Developing this cognitive ability will make it easier for children to master general knowledge, continue higher education, and lead daily life (Fauziyah, Ridwan et al. 2022). Armed with this knowledge, important to design learning media that generate a manageable cognitive load.

However, based on the initial observations in the ECE village in Langsa City, they have yet to go towards digitalization learning. There are obstacles for teachers in designing technology-based learning and barriers encountered in limited knowledge and media. So, in the cognitive aspects of development activities, children are less interested in getting involved. Children are usually passively dictated when introducing objects or just memorizing them. The use of technology-based learning media has never been implemented in the classroom.

Needs analysis is found in the presentation of material and media from teachers. In this case, the teacher needs to modify the learning media with something interesting. Relevant research has found that early childhood teachers struggle with finding and selecting appropriate applications to support student learning since many applications target preschool or elementary-aged students [7]. Due to the description of the problem, the researcher would like to optimize the use of technology-based learning media in solving existing problems. Through this guessing picture-fun learning, the hope is that children can learn actively to increase their cognitive abilities (Rambe 2019).

Several researchers have carried out research in the form of learning media for cognitive development, such as developing picture puzzle games [11,12], pop-up books [13,14], snake and ladder [15], Stepan [16], and counting media [17–19]. In addition, there is also research using a picture guessing game to improve children's problem-solving skills [20,21]. Meanwhile, this research aims to develop digital learning media to promote children's cognitive abilities with various features provided, attractive pictures, colors and sounds that early childhood heard immediately.

2 Methods

This research includes Research and Development (R&D) using the Borg & Gall model. In this research, researchers developed a digital learning media called "Who Game" to improve children's cognitive abilities aged 4-5 years. The Borg and Gall model consists of ten steps, including:

2.1 Research and information collecting.

The initial step in this development research is data collection through observation activities. Researchers conducted observations to analyze the needs and problems related to early childhood cognitive learning.

2.2 Planning.

At this stage, the researcher plans to develop the product:

1. Looking for a technology-based game model as a reference in developing digital learning media, but simple and easy to use.
2. Planning the contents of the development learning media with an appropriate theme, core competencies, basic competencies, and cognitive indicators.
3. Design the storyboard of media.

2.3 Develop preliminary form of product.

At this stage, the researcher begins to develop the initial form of the product. Included in this step is the preparation of supporting components, preparing game guidelines, and evaluating the feasibility of these supporting tools.

2.4 Preliminary field testing.

Initial field trials were conducted directly on three children aged 4-5 years at ECE Baiturrahim, Langsa city, Aceh. It is the first stage of the "Who Games" media tested by research subjects. Researchers made observations to obtain data on early childhood cognitive abilities as material for revising the product.

Main product revision. The initial product revision is to identify deficiencies and improve the animal-themed "Who Game" media so that the product develops widely.

Main field testing. This main field trial involved six children with the same age range as before, 4-5 years old. Researchers observed and recorded children's responses and reactions to be analyzed and tested in the main field as material for product improvement.

Operational product revision. The product will be revised when the field trial results are unsatisfactory or weaknesses and deficiencies based on input according to research subjects' result data.

Operational field testing. The next large field trial was on 15 students in group A aged 4-5 years, who played the game. It aims to find relevant data and obtain input

and corrections regarding the revised media product. Besides that, researchers also made observations and responses to the results of the final product.

Final product revision. From the data on the assessment of children's cognitive abilities, the researcher then revises and analyzes the deficiencies so that they get a learning media in the form of a technology-based learning media, "Who Game".

Dissemination and implementation. At this stage, the process of disseminating and implementing the developed product in the field is carried out.

2.5 Data Collection Technique

Researchers collect data through questionnaires and observation. This questionnaire is to obtain data regarding the feasibility of the product developed during expert validation. Moreover, the observation was conducted in this study before and after the product was developed, during the initial needs analysis and product field trials. In this study, indicators of children's cognitive aspects were limited to learning abilities and problem-solving, which included: recognition of objects based on function, the introduction of simple problem-solving concepts, recognition of objects as a game tool, and recognition of patterns of game activities.

2.6 Data Analysis Technique

The data analyzed included the feasibility of the media from material experts, media, and language from available questionnaires, as well as data on children's cognitive abilities. The measuring instrument used in this study is a questionnaire with a Likert scale. Furthermore, scoring rules for media experts, material experts, and linguists by the category: appropriate (4), adequate (3), less appropriate (2), and not appropriate (1). With the media eligibility category, the recapitalization of the validation data can be concluded based on the established categories so that the indicator for assessing the "who games" as digital learning media regarding the feasibility level. Digital learning media "Who Game" can be a viable product if the assessment results from the validator and students' cognitive ability are at least in the "Good Category".

3 Results and Discussion

The study's results are described based on the ten steps of the learning media development procedure using the development model from Borg and Gall, and then the findings are discussed in depth.

3.1 Research and information collecting

Based on the results of observations, researchers saw that in learning, especially when introducing pictures of animals, some children were less interested in the material being taught. This is shown by the behavior of children who are less focused on paying attention to the teacher and children who are busy playing alone. Some children

also look easily bored and bored when following the learning. The method used by the teacher in introducing this material is still monotonous and seems repetitive. The media used in the learning process only uses flashcards, picture posters, and whiteboard.

In this case, the teacher does not modify the learning media with something that can attract children's attention by introducing animal images to children. In addition, children are also less interested because activities are only limited to flash cards and posters of animal images. For this reason, researchers want to introduce animal image media differently, namely by using technology-based picture guessing games. The technology-based picture guessing game is a game that has never been done in the ECE. Not only is the media new to children, but the content in the game can also attract children's attention to do learning activities to recognize animals using technology-based picture guessing games.

From the results of the needs analysis, indicators of achievement of early childhood cognitive development refer to the standards of the Minister of Education of the Republic of Indonesia No. 137 of 2014 concerning Standards for Levels of Achievement of Early Childhood Development. Analysis of the standard level of cognitive development of children aged 4-5 specifically aims to clarify the direction of the development of cognitive learning media. Digital learning media is designed based on learning themes compiled and selected in the 2013 Curriculum in Kindergarten because learning in early childhood uses the concept of integrated learning through themes [22]. The material follows the cognitive development stages of children aged 4-5, focusing on learning concepts and problem-solving.

3.2 Planning

After finding some problems, researchers tried to plan the creation of technology-based learning media for animal picture guessing games. Researchers planned the media's name and the media's initial design using software (PowerPoint). Researchers also planned the content of media development-themed "animals" following looking at the syllabus for child development achievement indicators.

Product development is adapted to children's size, material, use and safety characteristics. In choosing media for learning and playing, teachers pay attention to the design features that are easy and simple, multifunctional, attractive, large in size, easy to use, durable and do not harm children [23]. Therefore, researchers developed a digital cognitive learning media that is attractive and easy to use, with a large screen display so that children will get a direct cognitive experience by playing with guessing pictures digitally.

3.3 Develop preliminary form of product

We named the digital cognitive learning media "Who Game". It is a development of the picture guessing game. Guessing games traditionally played usually use flashcards of various images. However, this media is created using PowerPoint and operated using electronic devices such as laptops/tablets and projectors. Studies from cognitive

psychology analyze how multimedia environments produce a cognitive load different from traditional learning situations because of the large amount of information. [24]. Through interaction with technology, as well as peers and adults, the child expands and adapts his or her understanding of the world with ever-increasing complexity [25]. The developed media is expected to overcome learning problems, optimize the learning process, improve children's abilities and create a fun learning atmosphere. One of the main principles in early childhood education is that the environment must be created in a fun, attractive and challenging way by paying attention to comfort and safety that can support children's play activities so that children can feel happy while doing every activity [26].

The theme was chosen in "who game" is "animals". The presentation of the material follows the stages of introducing animals. Animal selection is specified in animals that have four legs. Animal photos selected real animals in high resolution. In the game, there are clues for guessing animals, such as their characteristics, animal sounds, food, and hidden animal pictures. The voice game instructions are originally recorded from the human voice. The contents of "Who Game" can be seen in Figures 1 and 2:



Fig. 1. Initial Title Screen Display

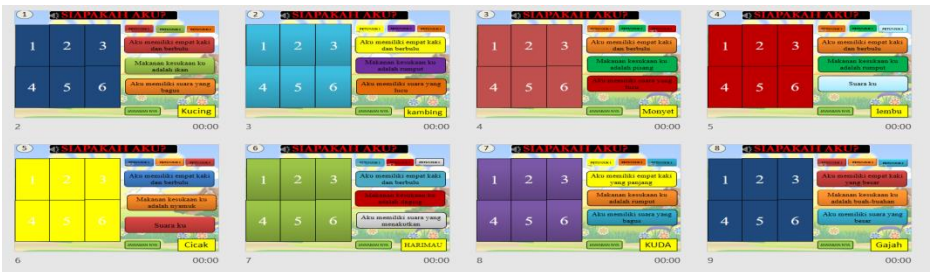


Fig. 2. General Content Display Before Playing

The media specification substantially contains material about introducing animal species by playing guess the picture. When guessing the picture, students get choices to make it easy to play the game. There are three options for the picture guessing game: the animal's physique, sound, and type of food. In this guessing game, children learn about animals, their shapes, sounds, food, and colors, and think critically.

Teachers can help children participate in digital media by asking probing questions about characters, sounds, game rules, and stories. Successful experiences in emergent provide children with opportunities to create new ideas and then evaluate them, often through their application to a particular environment or problem [25]. Learning is fun if there is an interaction between the teacher and students, the physical environment and the atmosphere that provides opportunities to create conditions conducive to learning [20].

In addition, this digital media can simultaneously introduce children to technology, laptops/computers. A projector visualized the game, and children played guessing together from the big screen. When used in developmentally appropriate ways, technology can facilitate more personalized learning to enhance learning opportunities for every student [27].

The procedure for operating the "Who Game" media for one of the pictures guessing game slides can be seen in table 1:

Table 1. The results of the validation of experts.

NO	Procedure	Display
1	Click the 'speaker' symbol, and a voice will appear "Siapakah Aku?"	
2	Click ' Petunjuk 1 ' once, then the reading will come out. If pressing the 'speaker' symbol under the words 'clue 1', a sound will appear according to what is written in clue 1.	
3	Click ' Petunjuk 1 ' once more time, and then a piece of the picture will appear.	

4 Likewise, in 'Petunjuk 2 & 3', pressing once will display text, and pressing twice will display a cutout.



5 Click 'Jawabannya', and then the correct animal answer will come out of the guess.



6 Finally, click the name of the animal, for example, 'Kucing', then all the boxes will open, and you can see the picture of the cat in its entirety.



After designing the product, the researcher validated the "Who Game" digital media on three experts; early childhood material experts, media experts, and linguists. The input from the three experts became a reference for product revision before preliminary, main, and extensive field testing. In addition, validation aims to determine how the media's eligibility according to reviews from experts in their field.

Expert validation data was obtained by providing a questionnaire that included early childhood cognitive learning materials. The expert examine at the suitability of the material for the development of the "Who Game" guessing game with the developmental stages of children aged 4-5 years, the suitability of appearance, the suitability of the level of difficulty, the suitability of text and illustrations with cognitive material, and the consistent use of symbols. Validation also attaches learning assessment indicator instruments and lesson plans. The results of the validation of experts shows in table 2:

Table 2. The results of the validation of experts.

No	Aspect	Percentage	Category
1	Media	88.37 %	Very Good
2	Content	93.3 %	Very Good
3	Language	82.25 %	Very Good

The validator provides suggestions regarding how to write down the characteristics of animals, which must be more specific and different from other animals. For example, the mosquito image should be replaced because it does not match the theme of four-legged animals, the colors in the game media, and the game procedure. In addition, the validator provides input to replace some parts of the game's initial appearance, which are simpler and reflect the picture guessing game, the placement of the image positions so that children are not easy to guess, the sound in the picture guessing game must be under the learning indicators, and speeder. They need to have learning indicators so teachers can evaluate based on the purpose.

**Fig. 3.** Main Screen Display Revision

3.4 Preliminary field testing

The initial field trial using the media "Who Games" technology-based picture guessing game involved three group A Baiturrahim ECE students. The filling of the assessment sheet was assisted by the researcher utilizing observation. Based on the observation assessment, the student's assessment of the initial field trial of the "Who Games" picture guessing game media obtained a result of 93.33%, and it can be said that the media is "feasible / very good."

3.5 Main product revision

Based on the initial field trial results, it is stated that the media "Who Games" or technology-based picture guessing game is feasible and very good for students of group An early childhood components that need to be improved, namely: a). Checking the projector cable so that it is not loose so that the displayed image does not disappear. b). Ensure that the lights do not go out when doing research.

3.6 Main field testing

The main field trial of "Who Games" media or technology-based picture guessing games involves six groups: A Baiturrahim ECE students. Based on observation assessment, students' assessment of the results of the main field trial of "Who Games" media or technology-based picture guessing game obtained a result of 95.18%, and it can be said that the media "Who Games" or technology-based picture guessing game "Worth/Very Good".

3.7 Operational product revision

The results of the main field trial state that the "Who Games" media is feasible and very good for use in learning group A students of PAUD Baiturrahim, so researchers do not revise the learning media products that have been developed.

3.8 Operational field testing

The operational trial of "Who Games" media involved 15 students of group A of Baiturrahim ECE. Based on the observation assessment, the results obtained are 98.85%, and it can be said that the media "Who Games" or technology-based picture guessing game is "Feasible / Very Good. From the results of observations on the trial implementation, research subjects' responses are generally very like, enthusiastic, and interested in the media "Who Games" or technology-based picture guessing games. The students were delighted to play the technology-based picture guessing game. Thus, this trial run received a very positive response from students.

After receiving input from the validators, the researcher made product improvements and then conducted field trials of the "Who Game" media in the field. The following is a graph of the results of the effectiveness test percentage:

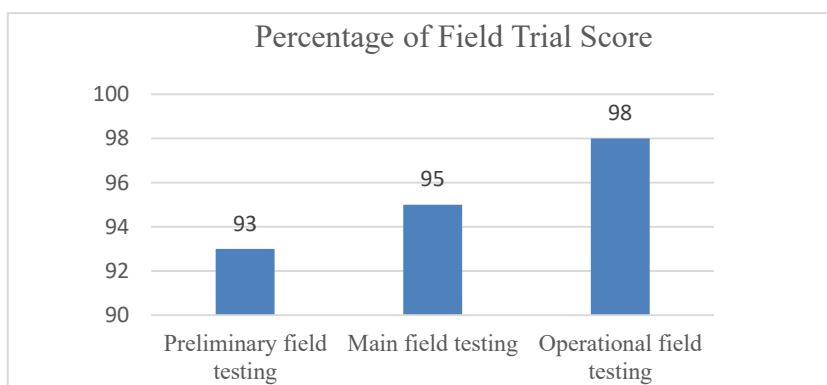


Fig. 4. Results of the effectiveness of using digital learning media “Who Game”

The results of the "Who Game" digital media field trial assessment of 3 children, 6 children, and 15 children aged 4-5 years at the Baiturrahim ECE showed very good cognitive abilities. In cognitive psychology, various studies have analyzed cognitive processes in complex learning situations using technology and internet tools [24], how activities in multimedia and network environments influence attention and cognitive load. All this evidence indicates that the great advantages of technology are for presenting information and making learning interactive, which generate specific alterations in the neuronal structure and cognitive processing in learning situations and task-solving.

Observations from a series of trials conducted by researchers have also seen that children are more attracted to bright colors. Baiturrahim ECE children who have never operated a laptop can become familiar with new technological tools. This media hoped could be learned by the teacher or for self-use by students. To increase educator confidence and proficiency, the teacher should follow training programs on setting up the devices, how and where to access and download applications, learning about different apps and relevant features, and troubleshooting problems in the digital era [28]. Educational technology must become a field or struggle of different interests, with different stakeholders involved: national, supranational, public and private (Selwyn, 2013).

3.9 Final product revision

The description of the final product of the "Who Games" media is divided into two categories, physically and substantively:

Physical specifications.

1. Technology-based picture guessing game "Who Games," a learning media that uses a laptop and a projector so that many children can play it.
2. The picture guessing game "Who Games" is made from PowerPoint software.
3. Every feature, such as images and sounds, downloaded from the internet
4. This guessing game has ten different picture slides; the more the game continues, the more difficult it is for children to guess.
5. This picture guessing game can be played by early childhood directly or in groups by following the teacher's guidance as a facilitator and companion at school.

Specifications in substance. "Who Games" media contains material about introducing types of animals by playing Guess the picture. When guessing the picture, students get choices to make it easy to play the technology-based picture guessing game. There are three choices from the picture guessing game: physical animal, sound, and type of food. In addition, this game media can introduce various colors and electronic devices used

Based on the results of the initial field trials, researchers evaluated several limitation in technical matters when learning occurred, such as checking the projector cable

so that the image was not lost, and preparing alternatives in case of power outages, as happened during field trials. The children's responses were generally very happy and very interested in learning with the technology-based "Who Game" media. Children seem interested and enthusiastic in playing the game "Who Game". Studies have found that young children are interested in learning digitally [29]. Children also easily understand and operate the game independently after being given an example by the teacher. In addition, today's children quickly understand digital media and touch screens. They are capable of operating, and navigational features allow young students to interact with the digital world by simply touching or tapping the screen. To conclude, the digital learning media "Who Game" can improve the cognitive abilities of early childhood.

4 Conclusion

Describe the development of the final product of the media "Who Games" divided into two categories: physically and in substance. Physically, the "Who Game" media is made using PowerPoint and is operated using a computer/laptop and a projector so that it can be seen clearly with a wide screen and many children can play together. This digital animal-themed guessing game has 10 slides of different four-legged animals. The more continue slide; the more difficult the level will be. Each image is collected from high-resolution images, and each sound is recorded as the original. Substantially, the media "Who Games" contains material about introducing animal types by playing a guessing game. The clues for the picture guessing game are in the form of the animal's physique, sound and type of food. In addition, this game media can introduce various colors and, at the same time, electronic devices to students.

The "Who Games" media is very good and very appropriate to be used as a digital learning medium to improve children's cognitive abilities focused on indicators: recognition of objects based on function, the introduction of simple problem-solving concepts, recognition of objects as game tool, and recognition of patterns of game activities. Hopefully, the "Who Game" media can be used as an alternative learning media by teachers to make the learning process in class more enjoyable. The "Who Game" media can be studied and developed to make it more perfect and innovative in further study.

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