Early childhood mathematical logic skills stimulation game using LLM (logical learning media)

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Abstract

Mathematics is often a frightening specter for most people, not least in early childhood, so there is a need for media that attracts children's enthusiasm to learn mathematics. The research objectives are: 1) to describe the development and feasibility of logical game learning media to stimulate early childhood mathematical logic ability; and 2) to determine the effect of logical game learning media on early childhood mathematical logic ability. This is research and development (R & D) with Borg & Gall development procedures. Methods of data collection using observation and interviews, as well as about the test results of learning. The resulting product is a logical game application. Material experts validated a value of 4,3 or 75% very feasible, while media experts validated a value of 3,65 or 70% feasible. The affectiveness test is analyzed using SPSS version 18. A one-sample t test (one-tailed) obtained = 17,631 > = 1,8333, which means it is rejected. The pre-test obtained an average score of 79.8, while the post-test obtained an average score of 96.1, with 100 completeness. The conclusion is that the application of logical games is effective and feasible as a learning medium to stimulate the mathematical logic ability of children aged 5–6 years.

Keyword: mathematical logic ability, logical game, learning media.

INTRODUCTION

Early childhood is the most potential period for children. In that period children easily receive stimulation from the environment around them to help the process of growth and development (Santrock, 2007; Sujiono, 2013). The capacity of parents and educators has a major impact in the developmental stages of children (Diadha, n.d.; Edi, 2015; Oktavianingsih, 2019; Pattnaik, 2013; Ramdan & Fauziah, 2019; Yulianingsih et al., 2020). The provision of the right stimulus using learning media will greatly help children to achieve optimal growth and development both from aspects of moral religious values, cognitive, language, physical, motor, social, emotional, and art (Kartini & Sujarwo, 2014; Rahmawati et al., 2016; Saurina, 2016; Suradinata & Maharani, 2020; Suyati et al., 2018). Therefore, stimulation in early childhood using learning media can be more effective.

All aspects of a child's development are important to stimulate. The aspect of cognitive development is one aspect of child development that is no less important to equip children to grow into individuals who have the ability to think logically, critically, and systematically according to the needs of the 21st century to help them solve problems (Nugraha & Mahmudi, 2015; Sumarmo et al., 2009; Zubaidah, 2017). However, research

states that the stimulation of this ability is still not optimal shown by data from research results in one kindergarten as many as 39% of children aged 4-6 years have many problems in cognitive development, then 37% of children are on the criteria of a lot, and there are only 17% of children who have very few problems in cognitive development, while 7% of other children do not have problems in cognitive development (Novitasari, 2018). Thus, stimulation of cognitive development to support children's ability to think logically mathematically still needs more attention.

Stimulation of mathematical logical thinking skills in early childhood needs to be supported by the use of various carrying capacities such as game activities, media, approaches, and so on. Early childhood learns through concrete things to an abstract one, therefore the use of media makes learning more concrete. Stimulation of mathematical logical thinking skills has been done with various efforts such as the use of scientific approaches, science games, animation media, multimedia-based learning has the main characteristic, namely the use of computers to combine various materials such as images, text, and sound (Kurniawati & Nita, 2018; Rahmat, 2015). Multimedia has proven to be effective in learning (Namiroh et al., 2018; Suryandaru, 2020). Therefore, multimedia through learning design that has been made can be an intermediary and facilitate students during the learning process. This is the reason for media developers to develop learning media that can encourage children to achieve an optimal learning process.

Therefore, multimedia through learning design that has been made can be an intermediary and facilitate students during the learning process. This is the reason for media developers to develop learning media that can encourage children to achieve an optimal learning process. Mathematics is considered a difficult, unpleasant, scary, even boring learning (Indofah, Vitriana & Hasanudin, 2023). Therefore, this problem needs to be solved immediately. Efforts to solve these problems have been carried out, namely equipping teachers with training, workshops, seminars related to methods or media that can be applied in the learning process. However, until now teachers still use a lot of monotonous media and are limited to the use of blackboards, magazine books or LKA that are already available so that children are still less interested and quickly bored with the media used mainly in early childhood of the current generation.

Games today are often interpreted as multimedia games that can be played using electronic devices and packaged attractively so that players feel enthusiastic, happy, and satisfied when playing the game. Based on the various understandings above, it can be defined that games are activities, goods, multimedia, or applications in which there are certain rules and packaged attractively so that they can be used to play. Currently, application-based

multimedia games are one of the various types of games that are now in great demand by various circles. Many researchers conduct research and development related to multimedia games to find out more deeply the usefulness of application-based multimedia games, one of which is the *logical game* application currently developed by researchers. *Logical game is an* Android-based application that is designed as attractive as possible and accompanied by instructions that can be played using electronic media *(mobile phones). This game* contains games related to mathematical logic that aim to help improve math and reasoning skills in children aged 5-6 years.

The intelligence of mathematical logic is defined as an advantage possessed by a person, especially in thinking logically (logic) and mathematics. In his book entitled *Multiple Intelligences: The Theory in Practice,* Gardner (2003) said that *mathematical logic* intelligence has two main factors that need attention. First, for those who are talented, the process of solving a problem usually occurs very quickly. Second, the solution to a problem can be prepared in advance before the solution is submitted. Thomas Armstrong quoted by Syarifah (2019) terms the intelligence of mathematical logic with logic smart (2002) or *number smart* (2005), namely sensitivity to logical patterns, calculations, categorization, and abstraction as well as the ability to use logic and numbers effectively, like the abilities possessed by logicians, mathematicians, scientists, and *programmers*. Thus, it can be understood that someone with *mathematical logic* intelligence has ability to categorize numbers and numbers effectively, calculate, and think logically and abstractly. Therefore, learning mathematical logic can be started early so that children have the provision of knowledge about numbers, calculations, and learn to think logically (reason) in solving and solving a problem.

RESEARCH METHODS

This research is Research and Development (R & D) using the Borg &; Gall (2007) model procedure modification to produce Android-based applications, namely logical game applications as learning media products developed results. The study was conducted in various places in the Ponorogo Regency area with research subjects aged 5-6 years.

The overall Research and Development (R&D) steps are carried out through three stages. First, the preliminary study is analyzing product needs by identifying problems, reviewing curriculum, and identifying product needs so that the products developed are in accordance with needs. Second, development design is to explain the process of making logical game applications. The final product is given to the validator of learning materials and media to assess the quality of the media product and obtain suggestions to revise the product. Furthermore, the product was tested. Third, product testing / evaluation is testing

the effectiveness of using logical game media to stimulate the logic mathematic intelligence of children aged 5-6 years.

Data collection in this study used observation (observation) and interviews as well as learning outcome test questions. The data that have been obtained are analyzed descriptively, qualitatively and quantitatively. The research data was obtained based on the assessment of material validators and learning media on the quality and feasibility of logical game application products that researchers developed. Data obtained through interviews during the main field test and operational field test were analyzed in a qualitative descriptive manner and the conclusions of the interview results were then used to revise the product. Feasibility assessment in terms of media display by users in the preliminary filed test and main field test is analyzed quantitatively through percentage and categorization techniques. Feasibility assessment by validators of learning materials and media is also analyzed quantitatively with percentage and categorization techniques, while a scale of five is used to convert statements into qualitative data. Data on pre-test and post-test results in the operational field test were analyzed quantitatively and compared to be tested for effectiveness with the t test one sample t test (one tailed) using SPSS version 18.

RESULTS AND DISCUSSION

This study describes the innovative and creative learning media needed by teachers to stimulate mathematical logic intelligence in children aged 5-6 years. This generation is a technology-literate generation where children since childhood are close and familiar with technology, including Android-based mobile phones. Taking advantage of children's closeness to current technology, interactive learning media are made that are presented attractively and can be installed directly on Android phones, namely logical game applications. This application contains instructions for using media as well as materials and quizzes related to logic mathematic, especially ages 5-6 years. Quizzes in logical games are presented in various types of logic mathematic games, namely learning to calculate quantities, mazes, addition operations, subtraction operations, compare, complete number patterns, puzzles, match images, and measurements. This is the basis for researchers to develop android-based applications.

Basically, teachers want to develop innovative and creative learning media that can stimulate and foster children's interest and enthusiasm for learning so that they can improve their abilities. According to R. Gagne (1989) quoted by Wandini and Sinaga, learning is the process of changing one's attitude as the result of the surrounding nature so that knowledge is obtained. In this case there is a reaction between stimulus and response. The stimulus

comes from the environment around while the response to the environment is a change in individual behavior. Therefore, there is a need for media that can optimize the child's learning process, especially learning mathematical logic. One of these media is media in the form of an Android-based application, namely logicalgame.apk which is designed using Microsoft Power Point software to be subsequently converted into an Android-based application so that it is easier to install and play by children and in accordance with the needs of today's children who in fact are a technology-literate generation. However, there are obstacles in the development of this media, namely the limitations of teachers in mastering and utilizing Microsoft Power Point software and using it as an interactive learning media in the learning process and the lack of teacher knowledge in making Android-based applications from basic designs using Microsoft Power Point software, as a result teachers convey learning to children only by using existing media such as books, whiteboards, magazines or children's worksheets.

Learning mathematical logic provided by teachers is only fixated on existing media and the learning process is mostly carried out with the lecture method so that children get bored faster and eventually consider that the learning of mathematical logic delivered becomes uninteresting. To change the stigma against learning mathematical logic, it is necessary to have learning media that attracts enthusiasm and enthusiasm for numbers to play it, especially in children of the current generation, where children have known Android phones from an early age. Taking advantage of this, an android application-based learning media was developed, namely logicalgame.apk which contains mathematical logic games and is presented with interesting images.

Research and development of logical game media broadly consists of 4 stages, namely: 1) conducting preliminary research, 2) initial product development, 3) product revision, 4) product trials, 5) final (final) products. Here is a breakdown of each stage:

1. **Preliminary Research**

    This stage is the product needs analysis stage, namely identifying problems so that the learning media products that researchers develop are in accordance with needs. Analysis at the preliminary stage consists of reviewing the curriculum and identifying product needs. a) Curriculum study is a study of the Early Childhood Education (PAUD) curriculum by analyzing the Child Development Achievement Level Standards (STPPA) and competencies for children aged 5-6 years, especially related to mathematical logic intelligence. This is so that the indicators and competencies that have been determined are in accordance with the development of logical game learning media products. b) Identification of product needs aims to see product needs in helping the teaching and learning process to achieve learning capabilities and objectives. Identification of needs,

among others, related to the media used by teachers, namely teachers providing mathematical logic learning still using children's activity sheets and blackboards; Teachers still tend to use lecture/classical methods in the learning process at school; and there are obstacles to using learning media, namely Microsoft Power Point software has not been mastered by teachers. In addition, teachers have not mastered how to make design files on Microsoft Power Point into an Android-based application that can be used as interactive learning media (Isroqmi, 2015; Muthoharoh, 2019).

2. **Initial Product Development**

Initial product development includes design, development, and production of logical game applications. The thing that needs to be done at the development design stage is the identification of the material needed to make the game. The material needed is material for ages 5-6 years, especially related to mathematical logic and adjusted to the Child Development Achievement Level Standard (STPPA). The next thing to do is to collect other supporting materials such as images, photos, audio and various software, namely CS6 photoshop software (Shaath et al., 2017), Microsoft Power Point 2016, WTPPT Converter, Java Runtime Environment (JRE) version 8, and makeApk software. These materials are needed in designing development products, namely logicalgame.apk.

The next stage is the production of logical game applications using Microsoft Power Point 2016 software. The software is an option because there is a complete menu such as sound effects, animations, actions, and other menus that can be adjusted and applied as needed. In addition, this software can also be added sound recordings in the form of audio that can be inserted in the parts that need to be given the sound effect. This software is simple without having to code in operation, making it easier for beginners.

The production stage of logical game applications is carried out through several steps, including: a) Open Microsoft Power Point software to create logical game media designs using materials (photos, images, and audio) that have been collected while setting file storage in ppt / pptx format. b) Starting a logical game creation project, starting with determining the title; create title screens, menus, instructions, materials, and quizzes; create a screen of each quiz; as well as creating a finish screen. c) The file conversion process is to change the file format of the design storage results from Microsoft Power Point which has a PPT / PPTX format using WTPPT Converter so that the file format becomes WTPPT / WTPPTX. d) The file generation process is made using makeApk software made by Touchshow from Whytouch so that the conversion results turn into an application. Before generating the file is done, make sure that the computer/laptop used to perform the generate process has Java Runtime Environment (JRE) version 8 installed. The

end result of generate is a logical game application (com.logicalgame.abc.apk) that can be installed on Android-based mobile phones.

3. **Product Trials and Product Revisions**

        The trial stage is the stage to test the developed product to material experts and media experts. Material expert validation obtained a score of 69 with an average of 4.3 which means it is very good or worthy of being used as a learning medium with revisions according to material expert comments. While validation by media experts obtained a value of 73 with an average of 3.65 which means good or worthy of being used as a learning media with revisions according to comments. Overall, the validation results show that logical game applications are suitable to be used as learning media for ages 5-6 years in stimulating children's mathematical logic skills.

        After obtaining suggestions for revisions and improvements from experts, further trials were carried out in stages, namely preliminary field tests, main field tests, and operational tests filed tests. Data from each test is analyzed and revised according to the results of each trial to produce the final product. The preliminary field test obtained a score of 4.03 which means that learning media in the form of logical game applications is categorized as "Good". In the main field test, the score was 4.07 or "Good", while the results in the operational field test were categorized as "Very Good" based on the average results of observational assessments to children of 4.68 and observations by users of 4.8.

        In the operational test filed test, children are given pre-test and post-test questions to see the effectiveness of using logical game applications on the mathematical logic ability of children aged 5-6 years. The average pre-test score is 79.8 while the average pre-test score is 96.1 where the value obtained by the child has reached the KKM provision, which is 75. The pre-test and post-test values are then compared to be tested for effectiveness using SPSS version 18 through the t test one sample t test (one tailed). The results of the t one sample t test obtained values (17.631) > (1.833), and the conclusion was rejected, meaning that there was a significant influence between the sample average and the specific average that had been set. Examining these results, it can be concluded that the product of development, namely logical game applications, is effectively applied in stimulating the mathematical logic ability of children aged 5-6 years. $t_{hitung} t_{tabel} H_0$

4. **Final Product**

        The final product is the final product produced after going through trials and revisions. The final product of this development is a logical game application (in apk file format.). This application makes it easy for users to install application files on Android phones or laptops / personal computers. Apk file. (com.logicalgame.abc.apk) is a logical

game application that contains games related to mathematical logic for ages 5-6 years as a medium to help stimulate children's mathematical logic skills.

CONCLUSION

This research and development resulted in a product in the form of an Android-based application, namely logicalgame.apk which serves to stimulate the mathematical logic ability of children aged 5-6 years. The resulting learning media in the form of applications can be installed on Android-based mobile phones and in it contains material related to mathematical logic in accordance with the indicators on the STPPA that have been analyzed.   Examining the results that have been obtained, it can be concluded that the product of development, namely logical game applications, is effectively applied in stimulating the mathematical logic ability of children aged 5-6 years.

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