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Interactive Media for Increasing Logical-Mathematical Intelligences in Differentiated Instruction Practice

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Abstract
Logical mathematical intelligence is important to be trained from an early age in the demands of 21st century competencies, because it is related to problem-solving ability, a logical thinking, and numerical processing skills in daily life practices of early children. One alternative way to increase this intelligence is to use interactive media as a practice of digitalization and differentiated instruction in learning activities. Based on the problem, this study aims to increase the logical-mathematical intelligence of early childhood through the implementation of interactive media in learning activities. This research method used pre-experiment design in the form of one group pre-test and post-test. The sample in this study were children aged 5-6 years with a total of 21 children. Data collection instruments using logical mathematical intelligence observation sheets. Data analysis techniques using paired sample t-test. The result of the data analysis showed that the Sig. (2 tailed) of 0,000 < 0,05. Thus, there is an effect of implementing interactive media to improve logical-mathematical intelligence in early childhood learning by using differentiated learning practices.

Keywords: *early childhood learning, differentiated instruction, interactive media, logical-mathematical*

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Introduction
In this digital age illustrates that today's generation is responsive and quick to adapt technology in various fields of life. In practice of early childhood education, technology takes a role in helping stimulate child development. Not infrequently found in the learning process in the classroom, teachers use smart technology as a learning medium for children during the process of playing and learning. Early childhood educators are exploring opportunities to integrate technology and interactive media into the present-day curriculum (Lyons & Tredwell, 2015). This was reinforced by children's awareness and interest in the learning process using technology (Kermani & Aldemir, 2015). Appropriate use of technology by teachers in learning can support the process of early childhood play and learning (Mantilla & Edwards, 2019). This is in accordance with the demands of the 21st century, which requires the use of technology in the learning process.

Access to technology is an important first step in the digital conversion of school systems; however, for the conversion to be successful, it is critical to move the focus beyond the technology itself, to how technology enables teaching and learning (McKnight et al., 2016). Teachers' own beliefs and attitudes about the relevance of technology to students' learning

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were perceived as having the biggest impact on their success (Ertmer et al., 2012). Thus, the application of technology in the form of interactive media can be used as a tool in the process of early childhood play and learning. However, the main focus is to instil in students a way of thinking that is closely linked to the ways of the discipline embedded in a humanist worldview (Mishra & Mehta, 2017).

Science will continue to develop at the pace of the times. Along with these developments, the science of pedagogy in educating children has also changed, because how to teach children in the current era will feel different from how to teach children in the past. This situation is a challenge for teachers, especially early childhood teachers, to foster good character in early childhood. Character education at early childhood produces character transformation at children and therefore character education at school needs to be done since early childhood (Sinaga, 2018), which is useful for preparing students from an early age to be able to compete globally in the future (Hasanah & Fajri, 2022). Various characters and intelligence need to be instilled from an early age, because early childhood is the foundation for them to prepare themselves for levels with more complex and specific learning outcomes.

Based on the trend of Indonesian students' PISA results in reading and maths from 2000 to 2018, it shows a downward trend despite three curriculum changes during this period. Therefore, the government needs to review and make radical curriculum changes that focus on strengthening the reading literacy and mathematical literacy (numeracy) aspects of students (Putrawangsa & Hasanah, 2022). Reflecting on these problems, the government has made various efforts to restore the gaps that exist in the education sector in Indonesia. Therefore, based on an in-depth analysis of these problems and the learning loss that occurred during the pandemic, the government issued a new policy in education, namely the implementation of the "Kurikulum Merdeka".

The restoration of learning is carried out at every level, including at the early childhood level, which is in the foundation phase (Kepmendikbud No. 262/M/2022). The learning paradigm shift applies to all levels. The early childhood phase is referred to as the foundation phase. This phase is fundamental in providing the basic framework for the formation and development of attitudes, basic knowledge and skills (Rizki Sapriani, 2019).

The new paradigm in classroom learning highlights that each child's learning needs are different. A new and different system needs to be created to meet the needs of all children (Stone, 2018). Significant emphasis of change occurs in intra-curricular activities, namely the learning process by implementing student centered learning differentiation, which means adjusting to the needs and characteristics of children. The application of differentiated instruction at the early childhood level is in accordance with the concept of learning to play in children so that they will have appropriate services according to age stages, thinking patterns and appropriate learning environment stimulation provided by educators (Lestariningrum, 2022), because each student likes a different learning style (Whitman, 2023).

Growing student diversity in today's classrooms calls for appropriate instructional strategies. Differentiated instruction is put forward as a key solution but seems challenging (Suprayogi et al., 2017) and teacher efficacy is an important dimension in implementing the differentiated instruction (Dixon et al., 2014) . Properly differentiated instruction supports teachers' efforts to stimulate children's multiple intelligences.

Students in Indonesia lag behind other countries in mastering science and technology (Sumardi et al., 2020). Compounded by the PISA ranking in numeracy with a declining trend, various other problems are found in classroom learning. Children's mathematical logical thinking skills have not yet emerged, especially in logical thinking and problem-solving skills. Problem-solving skill is one of the fundamental human cognitive processes. Whenever students face a situation where they do not know the way to complete a task, the problem occurs. Problem-solving is a process, which involves systematic observation and critical thinking to find an appropriate solution or way to reach the desired goal (Md, 2019). Problem-solving is one aspect of logical-mathematical intelligence that needs to be stimulated in early

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childhood. Because at the early age stage, children are still less able to think abstractly, so the learning process requires media that can meet the standards of child development (Hasanah & Fajri, 2022) .

Logical-mathematical thinking is an ability or thinking approach that uses the principles of logic and mathematics to analyze, solve problems, and make decisions. Mathematics for early childhood (4-6 years old) is a tool that can be used to increase the thinking ability, support the children to increase various of intellectual potential, as well as a medium to increase various attitude and positive habitual, in order to apply the basic personality as early as possible, such as critical and creative thinking ability, diligent, self-supporting, scientific, rational, etc. (Suripatty et al., 2019). Logical/mathematical intelligence included the aspects of symbolic thinking, problem-solving, and logical thinking (Rakimahwati et al., 2022).

Children's logical thinking skills will develop very rapidly if stimulated appropriately and teachers become the main role that can provide a conducive environment in helping to improve the abilities possessed by children, especially logical thinking skills (Rahmadhani & Surbakti, 2022). If the ability to think logically is applied from an early age, it will have a positive impact on the child's ability when facing a problem in his life (Ni Nyoman et al., 2018).

There are various efforts that can be used by teachers in improving logical-mathematical intelligence (Fisabilila et al., 2022). Logical-mathematical thinking in the realm of early childhood is an ability to develop organised and structured thinking patterns related to mathematical concepts. Some ways to stimulate mathematical logical thinking; 1) maths games; 2) maths stories; 3) grouping/classifying; 4) quantity recognition and concepts; 5) problem-based activities; and 6) pattern activities. Through fun and creative approaches like this, young children can develop a strong foundation for mathematical logical thinking. It is important to pay attention to individual developmental levels and customise learning approaches according to their needs and interests.

Early childhood logical-mathematical intelligence can be stimulated by playing geometry, puzzles, snakes and ladders and mathematical concepts (Ampolina & Fadlillah, n.d.). Thus, teachers need to design a lesson that can improve students' logical-mathematical intelligence level, both in general and on each indicator (Arum et al., 2018). Based on the explanation that has been explained, it is necessary to see the effect of using interactive media as a form of digitalisation in the learning process to improve the logical-mathematical skills of early childhood.

Methodology

This research used an experimental method with the type of pre-experiment in the form of one group pre-test post-test design. The **Figure 1** is a description of this research design.

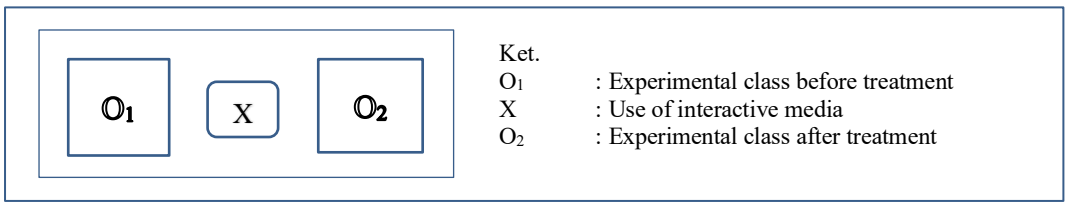

Figure 1. Research Design

This research was conducted at The Lab. School of PG-PAUD FKIP University of Lampung with a total of 21 children aged 5-6 years. Data collection instrument using logical mathematical intelligence observation sheets. Observation sheet using a checklist form with a scale of 1 – 4. To measure the achievement of mathematical logic using several aspects, namely; 1) processing numbers; 2) logical thinking; 3) problem solving. These aspects are scattered in several indicator points that are explained in the observation sheet. The hypothesis in this

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study is that there is an effect of using interactive media in improving children's mathematical logic. Hypothesis testing uses paired sample T-test analysis with the condition that the Sig. (2 tailed) <0.05.

Result and Discussion

The results showed a difference in pretest scores and posttest scores in the use of interactive media in the learning process. In the experimental class before using interactive media, it can be seen that the highest score in the aspect of logical thinking and the lowest score in the aspect of problem solving. After being treated with the use of interactive media in the experimental class showed an increase in value. The highest score in the aspect of processing numbers and the lowest score in the aspect of problem solving.

In this study, hypothesis testing used the Paired Sample T Test. Before testing the hypothesis, there are conditions that must be met, namely that the pretest and posttest data must be normally distributed. The results of the test get the Sig. value of the pretest and posttest data greater than 0.05, so it can be concluded that the variables are normally distributed. Furthermore, a paired sample T test was conducted to test the research hypothesis. From the test results, it is known that the Sig. (2 tailed) is 0.000 <0.05. Thus, Ho is rejected, so it can be concluded that there is an average difference between the pretest and posttest results, which means that there is an effect of applying interactive media in improving children's mathematical logical intelligence abilities.

Discussion

Children intellectual potential has been formed since 4 years old and children can consider shapes, measurement, and things based on their interpretation and experiences (Rosita Dewi Nur et al., 2019). The intelligence possessed by children can be developed in a way that is appropriate and suitable for children, therefore the selection of children's play equipment must be carefully selected so that this development can be optimised. (Ulya & Munastiwi, 2021). Logic-mathematical intelligence is developed in learning activities that are fun, effective, interesting, and meaningful (Tasliyah et al., 2020).

Mathematical logical thinking is useful in many fields, including science, technology, engineering, economics, and others. It is related to the skill of managing numbers or proficiency in using logic as mathematical logic intelligence essentially involves the ability to analyse problems logically (Suripatty et al., 2019). This intelligence leads to the ability to explore patterns, categories, and relationships by manipulating objects or symbols to conduct experiments in a controlled and organised manner (Wajannati, 2016). Mathematical logic intelligence includes sensitivity to logical patterns and relationships, statements and propositions, functions, and other related abstractions. The types of processes used in mathematical logic intelligence services include categorisation, classification, inference, generalisation, calculation, and hypothesis testing (Amstrong, 2009). In the popular teaching of mathematics, which is highly reliant on the logical-mathematical intellegence; students mathematical functioning is related to their mathematical/logical intellegence (Niroo et al., 2012).

Logical-mathematical intelligence on Early Childhood is the reflection ability of a concrete experience that is not defined by its physical form or its characteristics in the real world but through how much it relates to other mathematical ideas or situations (Luqmanul Hakim & Yanuarsari, 2017). Children's logical thinking skills will develop very rapidly if stimulated appropriately and teachers become the main role that can provide a conducive environment in helping to improve the abilities possessed by children, especially logical thinking skills (Rahmadhani & Surbakti, 2022). Logical-mathematical intelligence will also affect high order thinking. (Shuib et al., 2021).

Logical-mathematical intelligence can be developed through practice and a thorough understanding of mathematical concepts and practice in applying logic in problem solving.

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Mathematical logic intelligence is one of the important intelligences to develop because of the following: 1) Improves logic and strengthens thinking skills; 2) Discovering how patterns and relationships work; 3) Developing problem-solving skills; 4) Improving the ability to classify and categorise; 5) Improving memory (Astuti, 2018). If the ability to think logically is applied from an early age, it will have a positive impact on the child's ability when facing a problem in his life (Nyoman et al., 2018). Optimised logical-mathematical intelligence in children from an early age will be the basis for children to think logically (Suripatty et al., 2020).

The results showed the most influential increase in the aspect of number processing ability. Children are more responsive in recognising number symbols and other symbols. This is in accordance with a finding that at an early age, children begin to recognise some symbols and move on to the next stage of being able to solve simple problems concretely (Saputri et al., 2022). The ability to solve problems is one of the important abilities to be developed from an early age and the surrounding environment is a laboratory for children to develop these abilities (Widiastuti et al., 2018). Logical mathematical intelligence strongly influences mathematical problem solving ability (Irawan et al., 2016). Therefore, teachers need to emphasise stimulation to trigger children to identify problems easily and solve puzzles systematically.

Stimulation of mathematical logic intelligence in early childhood can be implemented with interactive media as the utilisation of technology in the learning process. It is imperative that children are introduced to technology starting from pre-school ages. An education setting surrounded by suitable technological products both promote, the children's development and increases motivation to learn (Can-Yaşar et al., 2012). In its implementation, it certainly prioritises the principle of early childhood learning through play. The mathematical play involved in early childhood education (Özdoğan, 2011), Despite the use of technological aids, the learning process still uses fun, physical activities in the classroom. Reinforced by the results of research showing that physical activity learning with games strategies increasing the logical mathematics intelligence(Siregar et al., 2023).

Developmentally appropriate technology and curriculum integration are also provided (Lee & Kim, 2019). The utilisation of technology in learning, by implementing various technology-based games, has turned out to be one of the innovative ways to improve various kinds of intelligence, one of which is logical-mathematical (Pérez et al., 2018). Thus, teachers need to design a lesson that can improve students' logical-mathematical intelligence level, both in general and on each indicator (Arum et al., 2018). Teachers' own beliefs and attitudes about the relevance of technology to students' learning were perceived as having the biggest impact on their success (Ertmer et al., 2012).

Teachers tried to vary the method and seating arrangement. Meanwhile, the tasks weren't modified to accommodate students with additional learning needs (Handayani & Sugoto, 2017). The use of interactive media in this study is implemented in the practice of learning differentiation in the classroom. Differentiation lies in process, product, and content differentiation. However, more emphasis is placed on process differentiation. This decision-making is based on the different learning styles of each child, so that in its implementation there are various kinds of learning processes, ranging from singing, moving, telling stories, etc. to get data on children's logical-mathematical skills. The positive impact of DI on their achievement. In addition, a tendency was found implying that differentiation by interests was the most effective type of adjustment. The results proved the applicability and positive impacts of DI in kindergarten classrooms (Mavidou & Kakana, 2019). Within the "multiple and heterogeneous" kindergarten classrooms that have young children with academic diversity, the implementation of "differentiated instruction" is truly valuable and useful in achieving the goals of considering individual differences and teaching with the student-center philosophy (Wu & Chang, 2015). Teachers pay more attention to the product and less the

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content and the differentiated learning process (Ismajli & Imami-Morina, 2018). When in fact, the learning process plays an important role for students in constructing the core lessons of each day.

Conclusion

Based on the results of data analysis, it shows that the application of interactive media has an effect on increasing children's mathematical logic intelligence supported by differentiated learning in the process of learning and playing early childhood in schools. The use of interactive media utilizes learning technology in the classroom, of course, the implementation is packaged in a learning that is interesting, fun, and according to the learning needs of each child with the principle of differentiated instruction. The researcher recommends that early childhood teachers and principals stimulate mathematical logic intelligence. This intelligence is a foothold for children to form a person who is capable of logical thinking, numeracy skills, and as a problem solver in daily life practices. Learning differentiation also needs to be familiarized by classroom teachers to fulfil the rights and learning needs of each child.

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