Indonesian Journal of Early Childhood Educational Research, 4(1) - June 2025 29-39

Indonesian Journal of Early Childhood Educational Research

ISSN : 2963-6760 (Online)
ISSN : 2962-1364 (Print)

Developing MEGA: A Geometry-Based Educational to Enhance Logical Thinking Skills And Visual-Spatial Skill

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Received: April 24, 2025	Revised: May 06, 2025	Accepted: May 09, 2025	Online: May 10, 2025

ABSTRACT

The development of logical thinking skills and spatial visual intelligence in children aged 4–5 years is essential for fostering early understanding of geometric concepts. Many children at this stage still experience difficulties recognizing basic geometric shapes such as squares, rectangles, triangles, and circles, along with identifying concrete examples from their surroundings. This study aims to develop and examine the MEGA (Media Edukasi Geometri Anak) application as a varied alternative learning medium to stimulate these abilities. The research applies a Research and Development (R&D) model with a one-group pretest-posttest design. A total of 25 children aged 4–5 years from Kindergarten Muslimat Kabuh were involved, with data gathered through observational research activities. The effectiveness of the application was analyzed using the N-gain test. Results indicate that the application effectively enhances logical thinking, enabling children to better recognize and distinguish geometric shapes. Furthermore, spatial visual intelligence develops, as children become able to identify colors, name vertical and horizontal lines within geometric drawings, and relate real-world objects to their geometric forms. These findings highlight meaningful improvements in children's cognitive and spatial abilities after engaging with the MEGA application, showing its potential as an alternative learning medium in early childhood educational settings.

Keywords: *Geometry, Logical Thinking, MEGA Application, Spatial Visual Intelligence*

Journal Homepage https://ejournaluinmybsk.ecampus.id/index.php/ijecer/index

How to cite: Miftahurrohmah, L., Matheos Lasarus Malaikosa, Y., Wulan Patria, S. (2025). Developing MEGA: A Geometry-Based Educational to Enhance Logical Thinking Skills And Visual-Spatial Skill. *Indonesian Journal of Early Childhood Educational Research (IJECER), 4(1),* 29-39. https://doi.org/10.31958/ijecer.v4i1.15177
Published by: Universitas Islam Negeri Mahmud Yunus Batusangkar, Indonesia

INTRODUCTION

Learning is an activity in the school environment. This term learning itself is related to learning and also learning. According to Suyono & Hariyanto et al., (2021) , learning is usually related to the learning process carried out by teachers and guiding children for the next life. Meanwhile, according to McPhail, (2021) learning is a way used by a person with a certain intention and applying the knowledge that exists in a teacher to achieve the goals of the curriculum. In the opinion of these experts, it can be explained that learning is a learning and

guardianship activity by teachers with professional knowledge and teaching and guiding children to achieve appropriate curriculum goals.

Learning media or resources used in the learning process as a tool to support learning activities. A statement from the *National Education Association* (NEA) in Lestari, (2023) argues that media is a form of communication that comes from print or audio-visual media and its equipment which has an important role both as a support for teaching activities and as a learning resource itself. The learning media will later become interactive multimedia for the implementation of learning. Development using digital media is used to improve children's understanding. Where according to Een Kurniasih, (2019) states that 10% of information is absorbed from reading activities, 20% from seeing activities, 50% from seeing and hearing activities, 70% from words spoken and 90% from pronunciations and actions taken. Based on this statement, it is important to use digital media to help the teaching and learning process to be more varied and fun for children. This is an alternative to the many activities carried out by teachers using LKA, so that learning activities are still lacking.this is supported by the explanation of Saleha et al., (2022) that children's skills are not just basic skills in reading, writing, and arithmetic. Language skills, computer literacy, interpreting images, and various efforts to acquire knowledge are some of the skills in learning activities.

This digital media is in the form of digital applications. Where in the application system consists of *software* used to perform a task (Novendri et al., 2019; N. D. Safitri et al., 2023). BPS, (2022) shows that 33.44% of early childhood children in Indonesia have skills in using mobile phones and 24.96% can also access the internet. This can also be seen where children are able to operate digital media, such as televisions, gadgets, personal computers (PCs) and ipad Putra & Ahmadi, (2021) this MEGA application media will later be used to introduce the form of geoemtry. The introduction of geometric shapes from an early age is important as a provision for learning to understand shapes and objects that will often be encountered by children. As children learn based on the characteristics of objects, children will learn to distinguish objects based on shapes Susanto, (2011) there are many geometric shapes that children can encounter in their daily lives. The introduction of geometric names should start with the objects around the child. Children learn to identify the shapes that exist in their environment. When children play using blocks, draw, paint, return blocks to shelves, cut geometric shapes, children are actually learning about building flat, building spaces and their functions.

The introduction of geometric shapes from an early age is important as a provision for learning to understand shapes and objects that will often be encountered by children. As children learn based on the characteristics of objects, children will learn to distinguish objects based on shapes Susanto, (Susanto, 2011) there are many geometric shapes that children can encounter in their daily lives. The introduction of geometric names should start with the objects around the child. Children learn to identify the shapes that exist in their environment. When children play using blocks, draw, paint, return blocks to shelves, cut geometric shapes, children are actually learning about building flat, building spaces and their functions.

Geometric shapes used to stimulate children's cognitive development. Cognitive development in early childhood involves the process by which children develop their cognitive abilities, such as understanding, thinking, and processing information Nurqodriah et

al., (2023) the focus of this ability is the child's logical thinking. which has been stipulated in the STTPA of the Minister of Education and Culture No. 137 of 2014 explains that the scope of consequential development is divided into 3, namely learning and problem solving, logical thinking and symbolic thinking. In logical thinking, children classify objects based on function, shape or color or size, recognize cause-and-effect symptoms related to themselves, classify objects into the same group or similar group or group. Then refer to the Standards, Curriculum and Education Assessment Agency No. 32 of 2024 to introduce shapes and classify objects included in the scope of Mathematics learning outcomes, so that here the concept of geometry is used to introduce geometric names and shapes (Haryani & Qalbi, 2021).

The ability to think logically is important to be developed optimally through the support of people around the child so that teachers also play an important role in helping the development of children's logical thinking skills. According to Coopley and Wortham Nurtaniawati., (2019) that teachers play a very important role in improving cognitive abilities. The aspect of early childhood cognitive development includes the sensorimotor stage (0-24 months) will go to the preoperational stage (2-7), at this preoperational stage the child cannot use logic, so it must be concrete. Therefore, this age is best suited for developing children's logical thinking. In developing children's logical thinking, there are several people who are very influential, one of which is the teacher, the teacher must provide a conducive environment that helps increase the potential of children. Not only the ability to think logically, but spatial visual intelligence is also important to be developed in children.

Spatial abilities are one of the important abilities that are useful for human life. Spatial ability is related to the capacity that individuals have to understand and remember the spatial relationships between geometric objects (Sukarti et al., 2023; Taylor & Tenbrink, 2013). Spatial abilities are often categorized into spatial visualization and spatial orientation (Cakmak et al., 2014) . Spatial visualization is described as the perceptual ability to manipulate visual images in two- and three-dimensional spaces, while spatial orientation refers to the cognitive ability to understand how one object is positioned relative to another object in space (Akayuure & Alebna, 2016). Two spatial abilities require a human thought process that is responsible for stimulating logical understanding and reasoning when solving geometric problems (Taylor & Tenbrink, 2013).

Problems with geometry recognition also occur in the school environment. Based on the results of observations, it was found that when at Muslimat Kabuh Kindergarten school, especially in class A with the age of 4-5 years with a total of 25 students, children can already recognize geometric shapes but still cannot distinguish geometric names and shapes that are included in the aspect of cognitive development, especially in the development of children's logical thinking. During learning activities to get to know geometric shapes, use the learning media of Children's Worksheets and also posters about geometric shape drawings. At the time of these activities, children were less enthusiastic and less interested in participating in learning activities about knowing geometric shapes if they only used media in the form of poster images provided at school. This results in when asked by the teacher they lack understanding about the classification of geometric shapes or distinguishing shapes.

Then when asked to provide real examples of geometric shapes, such as squares, rectangles, triangles and circles that exist in the environment around the child. Children still cannot name and look for examples of concrete objects in the environment around the child, especially in the environment around the child when in class or at school such as examples of square shapes that match the example taught, rectangles, circles or triangles. This makes children still unable to understand in children's visual spatial intelligence in terms of providing concrete examples around children, so that in learning activities to introduce geometric shapes there is no more varied learning media to attract children's interest and media that are able to develop several aspects of child development, so, this research aims to develop MEGA application media that can stimulate logical thinking skills and Spatial visual intelligence of children aged 4-5 years.

The development of MEGA application media is expected to be used as a learning medium by schools and teachers as one of the learning media that can be used to stimulate logical thinking skills and spatial visual intelligence operated through gadgets or personal computers. Then for education practitioners, the use of this media can be one of the variations in education by utilizing digital media that is adapted to the development of the current times, so that it not only uses LKA media but also other more varied learning media.

RESEARCH METHODOLOGY

Research uses a type of development research or known as *Research and Development* (R&D). This development refers to a procedural model using steps according to the stages both before the manufacture of the product and the production of a product. According to Sukmaddinata (2008) R&D is a research approach that produces a new product or improves an existing product. In this development, the ADDIE development model is used. This development research model is the ADDIE model. According to Mulyatiningsih, (2011) ADDIE development model consists of 5 stages, namely: analysis, *Design*, Development, Implementation, and *Evaluation*.

Then the trial design used using *a one group pretest-posttest design* will be able to be known for its accuracy by comparing the results of the pretest before being given treatment with the results *of the posttest* after being given treatment involving 25 children at Kindergarten Muslimat Kahub, Jombang. The research design in testing the effectiveness of MEGA media "Children's Geometry Educational Media" in Stimulating Logical Thinking Skills and Spatial Visual Intelligence of Children Aged 4-5 Years.

O1 X O2

Information:

O1 : *Pretest* Before treatment using MEGA media to improve logical thinking skills and Visual Spatial Intelligence of Children

O2 : *Posttest* After treatment using MEGA media to improve logical thinking skills and Visual Spatial Intelligence

X : Activities or Treatments using MEGA media to improve logical thinking skills and Visual Spatial Intelligence of Children

Then for the analysis of the data feasibility test, using a *likert scale* to get clear answers in the form of answers "strongly agree, agree, disagree, and disagree". The questionnaire data was obtained from the feasibility test of MEGA media applications to stimulate children's logical thinking skills and visual spatial intelligence. In the expert test, namely material experts by S2 PAUD lecturers and media experts, namely Professor of Educational Technology in the field of online learning models with validation tests that are feasible and can be tested. The questionnaire is calculated using the formula:

$$P = \frac{f}{N} \times 100\%$$

Information:

P : Percentage number

f : The frequency that is being searched for the percentage

N : Number of responses multiplied by the highest score multiplied by the number of questions

Then, to analyze the effectiveness of the use of MEGA media to stimulate children's logical thinking skills, it can be measured using the N-Gain test which uses *pre-test and post test* data. The use of the N-Gain approach to measure the relative change between the child's level of understanding before and after a learning. The following is the formula used for the N-Gain test:

$$N\text{-}Gain = \frac{Score\ of\ Posttest - Score\ of\ Pretest}{Ideal\ Score - Score\ of\ Pretest}$$

This pretest and posttest activity was carried out for 5 days with 1 day of pretest activities, then 2x treatment using the MEGA and postest applications. Activities are carried out in accordance with the RPPH and assessments are carried out by observation using the rubric of assessing logical thinking ability and spatial visual intelligence. To minimize distractions during learning activities, when learning activities are carried out accompanied by 2 teachers and introduction to using geometry media, you can use a projector to facilitate learning activities.

RESULTS AND DISCUSSION

Before the implementation of MEGA application media, several validations were carried out, namely media experts obtained results with a percentage of 100% without any revisions, then the validation of material experts obtained results with a percentage of 98.66% by adding quizzes in the application with accompanying materials to get 100% percentage results by printing accompanying materials. From the results of the percentage of several experts, it shows that the MEGA application "Media Edukasi Geometri Anak" as well as the accompanying material is included in the category of Feasible Level and Very Feasible to be tested (Sugiyono, 2013). The development of the MEGA application was developed by

paying attention to the learning experience and knowledge of children. The MEGA application can be used as a learning medium in teaching children to know geometric shapes.

In the implementation activity, it was carried out at Kindergarten Muslimat Kabuh involving class A children aged 4-5 years. There are several stages in learning activities. The first stage was conducted with *a pretest* activity using origami paper which was formed into square, rectangle, triangle and circle shapes. Then the children count and color using the Children's Worksheet and are used as a measuring tool for the child's initial assessment. In the second stage, then the intervention was carried out 2 times by developing the ability to think logically about geometric shapes such as squares, rectangles, triangles and circles, then on the second day the children were introduced to colors that existed in geometric shapes, such as red, yellow, green and blue. In the last stage, the *posttest* activity was carried out through the activity of cutting origami paper in the shape of a square into a rectangle then matching the shape through an example on the paper and pairing it with LEGO that matches its shape and color to develop logical thinking skills. Then the children were invited to draw geometric shapes and color, after which the children were invited to play using paste and mixed it into paper so that it became a lot of colors to develop the child's visual spatial intelligence.

The following is the result of a comparison *of pretest* and *posttest scores of* logical thinking skills and spatial visual intelligence of each child can be seen in the following graphic image :

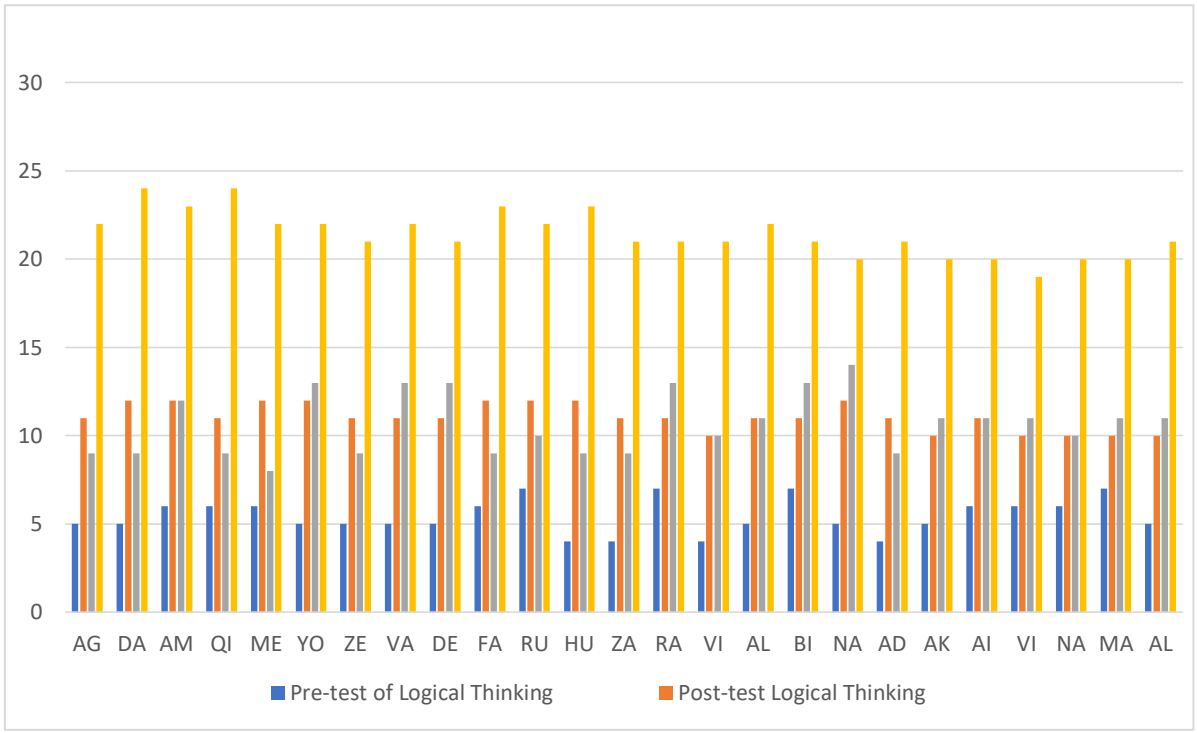

Figure 1. Pretest and Posttest Results

Based on the explanation of the diagram above, it can be concluded that *the posttest* activity shows a change in positive scores or can be interpreted as a change in value after the

application of *treatment* using the Media Edukasi Geometri Anak application to stimulate children's logical thinking skills and spatial visual intelligence.

After the stages of implementing *pretest* and *posttest activities*, data processing can then be carried out to determine the level of effectiveness of the MEGA application to stimulate children's logical thinking skills and visual spatial intelligence. The effectiveness test analysis uses *N-Gain Score* analysis using SPSS 20. The following is the calculation table:

Table 1.Results of Analysis *N gainscore*

Descptive Statistic					
Logical Thinking Skills					
	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain_score	25	.60	.10	.86	.1229
N-gain_persen	25	60.00	100.00	85.66	12.2905
Spatial Visual Intelligence					
N-gain_score	25	.60	.10	.80	.1077
N-gain_persen	25	60.00	100.00	80.03	10.77287

Based on the results of the calculation of the N-Gain test, the logical thinking ability score shows that the average N-Gain score is 0.86 with a high improvement category with a percentage of 85.66% including the effective category. Meanwhile, the N-Gain test of spatial visual intelligence score shows that the average N-Gain score is 0.803 with a high improvement category with a percentage of 80.03% including the effective category. Therefore, it can be concluded that the development of the MEGA application "Children's Geometry Educational Media" is effective in stimulating the logical thinking skills and spatial visual intelligence of children aged 4-5 years.

The effectiveness of mega media on children's logical thinking skills is based on indicators about recognizing geometric shapes names, distinguishing geometric shapes and classifying geometric shapes. Based on the results of the assessment rubric of logical thinking ability, the highest indicator in children's logical thinking, namely the child's ability to recognize the names of geometric shapes, children are able to recognize the names of square, rectangle, triangle and circle geometric shapes very well.

Where children do activities to get to know geometric shapes through origami paper and then cut into rectangular shapes and cut out sketches of circle shapes, while triangles are able to fold origami paper shapes into triangles and distinguish the names of each shape. This is supported by the research of Hapsari et al., (2019) which explains that the introduction of geometry in kindergarten includes the recognition of circles, triangles, and rectangles. The importance of introducing geometry to children is so that children can learn about the objects around them (Nieslen, 1993).

Meanwhile, the lowest indicator of the assessment results is when the child classifies geometric shape objects. In the activity of distinguishing shapes and classifying objects according to their shape, there are still children who have not been able to classify according to the example of the sketch on the paper that is matched with lego with the child being able to complete 2-3 shapes and colors accordingly, so that this indicator still needs to be re-

stimulated to match the indicators in stimulating the child's logical thinking ability. This is supported by Prihantoro, (2010) who explains that in the ability to think logically in understanding children, the process of identifying and remembering what has been learned by the child will be taught, while in the process of understanding children will be taught to classify, give examples, and group what the child has understood before.

The development of children's logical thinking skills still needs to be developed because in classifying children's shapes still requires stimulation, where children can only recognize the names of shapes from squares, rectangles, triangles and circles. Meanwhile, children's ability to classify shapes is included in the ability to think logically so that to be able to develop these aspects can be stimulated using the use of the MEGA application so that learning activities vary or using other technological learning media to stimulate the ability to think logically in classifying objects according to their shape. This is in line with research conducted by Boonroungrut et al., (2022) that the use of media that utilizes technology can produce active, collaborative learning and assisted by a supportive environment.

Then the effectiveness of mega media on children's spatial visual intelligence abilities is related to the child's indicators of recognizing colors, lines, shapes and sizes. Where to stimulate spatial visual intelligence adjusted to the child's learning characteristics through seeing, recognizing shapes, objects and colors, drawing (Amalina et al., 2022; Martuti, 2009; Rosdiani & Warmansyah, 2021; Warmansyah et al., 2023). The results of this study are based on several indicators with different levels of achievement. In the assessment indicator, the child's ability in spatial visual intelligence is highest when the child is able to recognize colors with geometric shapes very well. Where in this case children are able to recognize colors in the activities of the mixed pasta and also draw made by the child himself. Activities carried out by children can develop spatial visual intelligence with children being able to know the colors red, yellow, green and blue during coloring activities and pasta play activities.

This is included in the development of spatial visual intelligence supported by the research of (Oranç & Küntay, 2019) that the spatial visual world is the ability to capture colors and be able to combine colors when coloring and decorating, children's pleasure in doodling, drawing, imagining, making simple designs, children's ability to understand directions and shapes, and children's ability to create a shape. Then for the results of the lowest indicator in spatial visual intelligence, when the child does the activity of sorting objects from small to large, stimulation is still needed. In this activity, children still have difficulty distinguishing between large and small ones in the question and answer activity and when the difference in size is shown. Stimulation in the activity of sorting objects from small to large needs to be done to develop children's visual spatial abilities.

Stimulation is carried out to stimulate children's visual spatial intelligence in the measure indicator, children are able to do these activities. This is in accordance with the statement of (Kang et al., 2017) which explains that the strategy is to activate spatial visual intelligence, with children recognizing shapes and being sensitive to colors, the use of graphics to easily understand what children are learning and visualization of an object to help children translate verbal language into visual form. This research is in line with research conducted by Safitri & Mardiani, (2022) which states that application-based *game* media is effective in developing children's spatial visual intelligence by recognizing shapes and colors.

Another research was conducted by Imara et al., (2024) with the development of a digital-based PUTRI game "Geometry Puzzle" to stimulate the spatial intelligence of children aged 4-5 years effective to increase spatial intelligence in recognizing shapes and colors with a very high level of effectiveness. Based on the application of the MEGA application, the MEGA application can be said to be effective in developing children's spatial visual intelligence. Where in this application there is also a *game* that contains *puzzle games*, as well as matching colors and shapes using the MEGA application as a stimulation to develop children's spatial visual intelligence.

CONCLUSION

MEGA Application Media is suitable for use to improve children's logical thinking skills and visual spatial intelligence with the results of expert assessment validation tests. The results of the material expert validation test with a percentage of 98.66%, the media expert validation test with a percentage result of 100% and the accompanying material also received a percentage value of 100% which was included in the valid criteria and was very suitable for use. MEGA application media is effective in improving logical thinking skills which are seen based on indicators of logical thinking ability of children who are able to recognize geometric shapes, but for the ability to distinguish and classify they are included in the category of ability but need to be improved again. MEGA application media is effective in improving children's visual spatial intelligence seen based on indicators of children being able to recognize colors, and distinguish between large and small. Meanwhile, the child's ability to sort objects from the smallest to the largest still needs stimulus again.

ACKNOWLEDGEMENT

Thank you to the state university of Surabaya for giving me the opportunity to pursue further education and gain more knowledge at S2 PAUD FIP State University of Surabaya. Then the researcher also expressed his gratitude to the Kabuh Muslimat Kindergarten for giving me the opportunity to be able to conduct research activities, so that my research related to early childhood development could be completed.

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