
The Use of Educational Puzzle Games for the Development of Cognitive Abilities of Children Aged 5-6 Years

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Abstract

Development in early childhood is the most critical thing in children's future growth, and child development will also determine when children grow up. One aspect of child development that is important to develop is the cognitive aspect. An exciting method is needed to stimulate the spatial abilities as well as fine motor skills of children. One of them is a Puzzle game. Children's cognitive development can increase optimally by playing a Puzzle game tool because they have to solve puzzles from Puzzle pieces to form the appropriate image pattern. This study was conducted using a qualitative approach, descriptive type, where the goal is to observe and understand the behavior of children or groups in certain situations without being known by the child to see if there are differences in the optimization of cognitive development between each child. Based on the results of research that has been done, Puzzle educational games can stimulate early childhood cognitive development. It is shown by the fact that most of the children observed could put the Puzzle pieces back together into a suitable shape. They can also coordinate eyes and hands in the process of joining Puzzle parts and identifying geometric shapes well.

Keywords: children, cognitive ability, development, puzzle game

Abstrak

Perkembangan pada masa anak-anak adalah hal yang paling penting pada pertumbuhan anak di masa mendatang, perkembangan anak juga akan menentukan saat anak beranjak dewasa. Salah satu aspek dalam perkembangan anak yang penting untuk dikembangkan ialah aspek kognitif. Untuk mengembangkannya diperlukan metode yang menarik dan mampu merangsang kemampuan spasial sekaligus keterampilan motorik anak dengan baik. Salah satunya ialah dengan permainan papan Puzzle. Dengan memainkan alat permainan Puzzle perkembangan kognitif anak dapat bertambah optimal, karena harus memecahkan masalah dari potongan-potongan Puzzle agar membentuk pola gambar yang sesuai. Penelitian ini dilakukan dengan menggunakan pendekatan kualitatif jenis deskriptif, di mana tujuannya ialah untuk mengamati dan memahami perilaku anak atau kelompok dalam situasi tertentu, tanpa diketahui oleh anak agar dapat melihat apakah ada perbedaan optimalisasi perkembangan kognitif antara masing-masing anak. Berdasarkan hasil penelitian yang telah dilakukan, bahwa permainan edukatif Puzzle mampu merangsang perkembangan kognitif anak usia dini. Hal ini ditunjukkan dengan fakta bahwa sebagian besar dari anak-anak yang diamati mampu menyatukan kembali potongan-potongan Puzzle tersebut menjadi bentuk yang sesuai. Mereka juga mampu mengkoordinasikan mata dan tangan dalam proses penyatuan bagian-bagian Puzzle serta mengidentifikasi bentuk geometri dengan baik.

Kata kunci: *anak-anak, kemampuan kognitif, pengembangan, permainan puzzle*

A. Introduction

Cognitive ability is a very vital ability for good Child Development. The development of children's cognitive abilities helps develop their perception based on what they see, hear, and feel. Thus the child will have a complete understanding and train his memory about all the events experienced. In addition, children can also reason Well naturally or scientifically so that later they can solve life problems they face independently.¹

Cognitive ability is the ability of children to have complicated thoughts when solving problems, and cognitive development will make it easier for children to have a piece of extensive knowledge so that children can reason in a community environment.² With cognitive development, children will also be able to think in detail about solving problems they face, such as playing Puzzle educational games. Children will pay attention to the details of how to present Puzzle pieces that are suitable to be put together.

¹ Furi Mirna Sari and Darsinah, "Upaya Meningkatkan Kemampuan Kognitif Anak Melalui Media Jigsaw Pada Anak Kelompok B-1 Di RA Al-Islam Kadipiro Kecamatan Sambirejo Kabupaten Sragen Tahun Ajaran 2012/2013" (Universitas Muhammadiyah Surakarta, 2013).

² Yesi Novitasari, "Analisis Permasalahan "Perkembangan Kognitif Anak Usia Dini",
PAUD Lectura - Jurnal Pendidikan Anak Usia Dini 2, no. 1 (2018): 82-90,
<https://doi.org/https://doi.org/10.31849/paudlectura.v2i01.2007>.

An essential part of cognitive ability is spatial ability. Geary summarized his research results that various psychometric studies have consistently identified spatial ability as a broad domain of human cognition.³ Spatial ability is one of the aspects of child intelligence that has been recognized as a practical skill for Child Development. Within these capabilities is the involvement of retrieval, retention, and transformation of visual information specifically. Spatial ability is one of the cognitive tools used in problem-solving activities, especially when manipulating and processing visual-spatial information.⁴

Spatial ability is considered a trait of individuals with particular relevance who study advanced scientific and technical material, which is an essential ability to produce contributors in outstanding fields of Science, Technology, Engineering, and mathematics.⁵ Even in Indonesia, the spatial ability is one of the components tested in the potential academic test by the government agency in the National Development Planning (BAPPENAS) field.⁶ Various talent scouts generally make a measure of spatial ability as one of the selection criteria to attract young people who are intellectually capable and have educational experience in the fields of architecture, engineering, robotics, and Physical Sciences.

From the view of maturity theory, development is influenced by the genetically programmed structural maturation of the brain. That is, heredity is the main trigger. However, environmental influences become the force that most affects development when viewed in terms of learning skills.⁷ For this reason, in the preschool period, various stimuli to develop cognitive and spatial abilities are essential for early childhood. The preschool period, or the golden age, is the optimal growth period to develop aspects of children, one of which is the cognitive aspect, where children at the age of golden are prepared to enter school to the next level. Cognitive development competencies can make children think broadly in solving their problems.

³ David C. Geary, "Spatial Ability as a Distinct Domain of Human Cognition: An Evolutionary Perspective," *Intelligence* 90 (2022), <https://doi.org/https://doi.org/10.1016/j.intell.2021.101616>.

⁴ Ahmad Rafi et al., "Improving Spatial Ability Using a Web-Based Virtual Environment (WbVE)," *Automation in Construction* 14, no. 6 (2005): 707–15, <https://doi.org/https://doi.org/10.1016/j.autcon.2004.12.003>.

⁵ Jonathan Wai, David Lubinski, and Camilla P. Benbow, "Spatial Ability for STEM Domains: Aligning Over 50 Years of Cumulative Psychological Knowledge Solidifies Its Importance," *Journal of Educational Psychology* 101, no. 4 (2009): 817– 835, <https://doi.org/https://doi.org/10.1037/a0016127>.

⁶ Devita Rulyana and Rohmat Indra Borman, "Aplikasi Simulasi Tes Potensi Akademik Berbasis Mobile Platform Android," in *Seminar Nasional FMIPA-UT 2014* (Universitas Terbuka, 2014).

⁷ Torkel Klingberg, "Childhood Cognitive Development as a Skill," *Trends in Cognitive Sciences* 18, no. 1 (2014): 573–79, <https://doi.org/https://doi.org/10.1016/j.tics.2014.06.007>.

However, unfortunately, the improvement of spatial abilities and effective methods in developing spatial abilities are rarely considered a particular field of study in early childhood education.⁸ A study in Indonesia reveals that there are still many kindergarten students with difficulties in visual-spatial abilities. Students need help distinguishing right and left directions, recognizing colors, and remembering geometric grouping shapes.⁹

The development of cognitive aspects can also be improved through play, such as using Puzzle educational games. Using a Puzzle game tool, children will learn to solve problems by putting together Puzzle pieces until they are correctly arranged into an image. Puzzle games can effectively improve children's cognitive development through interaction.¹⁰ A study by Pratiwi et al. describes the importance of puzzle games as a learning medium to stimulate children's cognitive development.¹¹

Play is significant for early childhood because, at this age, play can make the development of aspects in children more developed quickly, such as cognitive development in children. According to Piaget, children are born with several sensorimotor schemes that provide the framework for the child's first interaction with the environment.¹² This sensorimotor scheme determines the child's first experiences. In other words, Only those events that can be assimilated into the scheme can be responded to by the child. Therefore these events will determine the boundaries of the child's experience. Nevertheless, through the child's experience, this initial scheme is modified.

Based on what was discussed above, this study was conducted. This research aims to see the extent of early childhood development of cognitive aspects after the puzzle game, then observe how their activities in these activities. The researchers, in this case, have observed several early childhoods in a kindergarten, whose age is 5-6 years. There are 4 of them who already understand and know how to put the Puzzle pieces together and how to complete the puzzle into a picture. While 1 in 5 children still finds it difficult to arrange the Puzzle pieces and still can not bring up the

⁸ Chien-Heng Lin and Chien-Min Chen, "Developing Spatial Visualization and Mental Rotation with a Digital Puzzle Game at Primary School Level," *Computers in Human Behavior* 57 (2016): 23-30, <https://doi.org/https://doi.org/10.1016/j.chb.2015.12.026>.

⁹ Laily Rosidah, "Peningkatan Kecerdasan Visual Spasial Anak Usia Dini Melalui Permainan Maze," *Jurnal Pendidikan Usia Dini* 8, no. 2 (2014): 281-90.

¹⁰ Zhenjun Zhou and Lili Wu, "The Study of Principles of Puzzle Game Design," in *2012 International Symposium on Information Technologies in Medicine and Education* (Hokkaido: IEEE, 2012), <https://doi.org/10.1109/ITiME.2012.6291487>.

¹¹ Rita Dwi Pratiwi, Riris Andriati, and Fenita Purnama Sari Indah, "The Positive Effect of Educative Game Tools (Puzzle) on Cognitive Levels of Pre-School Children (4-5 Years)," *The Malaysian Journal of Nursing* 11, no. 3 (2020): 35-41, <https://doi.org/https://doi.org/10.31674/mjn.2020.v11i03.006>.

¹² B. R. Hergenhahn and Matthew H. Olson, *Theories of Learning*, trans. Tri Wibowo BS, 7th ed. (Jakarta: Kencana Prenada Media Group, 2010).

visual image of the puzzle, when the child plays the puzzle does not feel fun and will feel bored.

B. Method

The research used a descriptive qualitative research method. Qualitative method descriptive types in use for Social Research.¹³ The study was conducted in a kindergarten located in West Java for several weeks. Some informants involved include kindergarten teachers, parents, and some children. Researchers use several techniques to capture data: observation, interview, and documentation. Observations have been made on four early childhood who are being given a board puzzle game. Some supporting data was obtained through documentation techniques, such as data related to student learning achievement reports.

C. Result and Discussion

The puzzle game used in this research uses a puzzle board consisting of cut parts. This Puzzle Game is a game that has a mechanism to arrange images into a single unit by paying attention to shape, color, and size. This game can be done by disassembling and reassembling puzzle pieces based on shape, pattern, or color. When put together, each piece forms an image pattern with rich colors.

Each observed child is given one puzzle board and the challenge to reunite the puzzle pieces into a whole picture. The time required by each child varies. Some take 7 minutes, 10 minutes, 15 minutes, or even more.

This research showed that using Puzzle educational games in children aged 5-6 years in kindergarten contributes positively to their interest in learning. Puzzle educational game tool is optimal for children's cognitive development, from problem-solving to hand-eye cooperation, so children have the expertise to explore various things according to their abilities and interests.

Based on observations made on children aged 5-6 years in kindergarten, obtained the fact that 3 out of 4 children have experienced optimal cognitive development after getting treatment with the use of educational tools and Puzzle games. However, 1 in 4 children who were the subject was still optimal in cognitive development beluum despite having been given a Puzzle game.

1 in 4 children admitted to having difficulty recognizing shapes quickly. It took him a few minutes to describe an object precisely in his mind. Some children still need to be dexterously imagine the picture visually on the

¹³ D.F. Polit and C.T. Beck, *Nursing Research: Generating and Assessing Evidence for Nursing Practice*, 10th ed. (Philadelphia: Wolters Kluwer Health, 2017).

puzzle. They have to look at examples of what their friends are already working on to find a suitable visual image.

At the same time, children who face obstacles in the puzzle game have problems in social communication with the people around them. He needs to communicate fluently and take longer to digest the words spoken by the interlocutor. Nevertheless, he solved the puzzle in the end, even though it was slower than the rest of his friends.

Table 1
Assessment Instrument

Variable	Cognitive Development	Sub-Indicator	Item	Total
Cognitive Development	Visual image imagining	The child can imagine the picture on the puzzle visually.	Children can complete the puzzle in an appropriate image	3 Children
	Recognize puzzle pieces	The child can recognize the pieces of the puzzle.	Children can put together puzzle pieces into the correct image	4 Children
	Recognize the shape of puzzle pieces	The child can recognize the shape of puzzle pieces	Children can recognize puzzle pieces to unite the puzzle parts in accordance	4 Children
	The child quickly completes the Puzzle pieces.	The child quickly completes the Puzzle pieces.	The child can complete the puzzle pieces quickly into corresponding pieces	3 Children
The number of children is growing well:				3 Children
The number of children begins to grow:				1 Child

Based on the results of observations and assessments, there are still children whose cognitive development abilities are in the developing category. Furthermore, there are also children whose cognitive development has developed as expected and is developing very well. The results of the assessment are presented in the following table:

Table 2
Assessment Result

N.	Name	Indicator	Description
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		1	2	3	4	
1.	ZF	BSB	BSB	BSB	BSB	<i>BSB</i>
2.	CL	BSB	BSB	BSB	BSB	<i>BSB</i>
3.	QS	BSB	BSB	BSB	BSB	<i>BSB</i>
4.	AF	MB	BSB	BSB	BSH	<i>BSH</i>

Description:

BB : Belum Berkembang (Undeveloped)

MB : Masih Berkembang (Still Growing)

BSH : Berkembang Sesuai Harapan (Develop As Expected)

BSB : Berkembang Sangat Baik (Very Well Developed)

The activity of children while playing puzzle board is also an indication of the development of their ability to recognize shapes and colors. It is confirmed by the results of interviews conducted with the class teacher. He admitted that children who can solve puzzle board games well tend to know shapes and colors well. To make sure, researchers have observed and tested the child's ability to recognize shapes and colors. The result is impressive. 3 out of 4 children who complete the puzzle board will be able to answer questions about geometric shapes and colors correctly.

Related to the result, a study conducted by Sari et al. showed that children tested in the experimental group showed a more remarkable ability to know geometric shapes and fine motor skills than children in the control group. In addition, research has proven that geometric puzzle games can be an effective way to help students develop the ability to know geometric shapes and fine motor skills.¹⁴ Thus, it has been proven that puzzle games can contribute to children's ability to recognize various geometric shapes. Among the indicators is the ability to describe, use, and visualize geometric arrangements and shapes.

According to Verdine et al., children's experiences with spatial toys such as puzzles and other shape games also significantly influence the early development of their spatial skills. In turn, spatial skills are essential to their success in science, technology, engineering, and Mathematics (STEM).¹⁵

¹⁴ Yuniarini Kuspita Sari, Wahyu Sukartiningsih, and Miftakhul Jannah, "The Effect of Geometric Puzzle Game Towards Children's Recognition of Geometric Shapes and Fine Motor," in *Proceedings of the 2nd International Conference on Education Innovation (ICEI 2018)* (Atlantis Press, 2018), <https://doi.org/https://doi.org/10.2991/icei-18.2018.75>.

¹⁵ Brian N. Verdine et al., "Finding the Missing Piece: Blocks, Puzzles, and Shapes Fuel School Readiness," *Trends in Neuroscience and Education* 3, no. 1 (2014): 7-13, <https://doi.org/https://doi.org/10.1016/j.tine.2014.02.005>; Gökçe Elif Baykal et al., "Developing Transmedia Puzzle Play to Facilitate Spatial Skills of Preschoolers," in *Proceedings of the The 15th International Conference on Interaction Design and Children*, 2016, 631-636, <https://doi.org/https://doi.org/10.1145/2930674.2936006>.

The current study examined the relationship between children's early puzzle play and their spatial skills. Children and parents (n 53) were observed at home for 90 min every four months (6 times) between 2 and 4 years of age (26 to 46 months). When children were four years six months old, they completed a spatial task involving mental transformations of 2-dimensional shapes. Children who were observed playing with puzzles performed better on this task than those who did not, controlling for parent education, income, and overall parent word types. Moreover, among those children who played with puzzles, the frequency of puzzle play predicted performance on the spatial transformation task. Although the frequency of puzzle play did not differ for boys and girls, the quality of puzzle play (a composite of puzzle difficulty, parent engagement, and parent spatial language) was higher for boys than for girls. In addition, variation in puzzle play quality predicted performance on the spatial transformation task for girls rather than boys. Implications of these findings and future research directions on the role puzzle play in developing spatial skills are discussed.¹⁶

A study once conducted by Aral et al. aims to investigate the influence of puzzle prototype activities on the developmental areas of preschool children, including cognitive, which led to the conclusion that the implementation of puzzle prototypes makes a significant contribution to the development of children. The study also states that puzzles are an effective educational material to support children's cognitive, language, motor, social and emotional development. In addition, using puzzles is also beneficial to develop their creativity and self-care skills and provides learning during play.¹⁷

According to Jirout and Newcombe, when trying to solve a puzzle, a child uses mental rotation to match pieces of a picture.¹⁸ Children at 5, 8, and 11 years old and adults can perform mental rotation tasks while simultaneously rotating their hands (guided by the handle). The direction of manual rotation can be compatible or incompatible with the direction of mental rotation.¹⁹

In addition to the various benefits above, puzzle games have an entertaining and recreational effect. Children enjoy installing puzzle pieces

¹⁶ Susan C. Levine et al., "Early Puzzle Play: A Predictor of Preschoolers' Spatial Transformation Skill," *Developmental Psychology* 48, no. 2 (2012): 530–542, <https://doi.org/https://doi.org/10.1037/a0025913>.

¹⁷ Neriman Aral, Figen GURSOY, and Munevver Can Yasar, "An Investigation of the Effect of Puzzle Design on Children's Development Areas," *Procedia - Social and Behavioral Sciences* 51 (2012): 228–33, <https://doi.org/https://doi.org/10.1016/j.sbspro.2012.08.150>.

¹⁸ Jamie J. Jirout and Nora S. Newcombe, "Building Blocks for Developing Spatial Skills: Evidence From a Large, Representative U.S. Sample," *Psychological Science* 26, no. 3 (2015): 302–10, <https://doi.org/https://doi.org/10.1177/0956797614563338>.

¹⁹ Andrea Frick et al., "Motor Processes in Children's Mental Rotation," *Journal of Cognition and Development* 10, no. 1–2 (2009): 18–40, <https://doi.org/https://doi.org/10.1080/15248370902966719>.

and feel challenged to solve them. A study has tried to develop an application called Collaborative Puzzle Game (CRPG), designed to explore the effects of forced collaboration (EC) in contexts where visuospatial abilities are required without relying on narrative skills. As it turned out, the results showed that none of the participants left the game before completing the puzzle. This activity was not so cognitively burdensome for the children involved in the study.²⁰

The various benefits resulting from the puzzle board game activity are proven to be very good in stimulating children's cognitive development, one aspect of which is spatial ability. Children and adults may also get similar benefits from the game to overcome the slowing of cognitive abilities. It is confirmed by a study that states that Americans believe they can improve brain health through their lifestyle choices. Eighty-four percent of them reported doing things to improve their brain health, including Arts, Crafts, Hobbies, games and puzzles, and exercising physically.²¹ It proves that playing puzzles is among the activities of interest to maintain human cognitive functions.

According to Mulyasa, the development of cognitive knowledge in early childhood can be implemented through exciting games, such as playing puzzle boards, to improve the child's thinking knowledge. Playing in early childhood can teach many things, such as recognizing rules, socializing, positioning self, managing emotions, tolerating, cooperating, and upholding sportsmanship.²²

Preparing children to continue to the next level of cognitive development is one aspect of development that is very important to improve children's knowledge. Cognitive for early childhood can make children think more complexly in solving the problems they face because the breadth of knowledge that children have makes them able to reason in solving problems. According to Montessori, the sensitive stage in children of this age includes sensitivity to environmental laws, exploring the environment with the tongue and hands, walking, sensitivity to small objects and details, and social aspects of life. Erik H. Erikson considers the age stage of 4 to 6 years as the initial stage.²³ For this reason, cognitive development in children is significant to continue to strive for, especially in the early days of growth.

²⁰ Alberto Battocchi et al., "Collaborative Puzzle Game: A Tabletop Interface for Fostering Collaborative Skills in Children with Autism Spectrum Disorders," *Journal of Assistive Technologies* 4, no. 1 (2010): 4–13, <https://doi.org/https://doi.org/10.5042/jat.2010.0040>.

²¹ Asenath La Rue, "Healthy Brain Aging: Role of Cognitive Reserve, Cognitive Stimulation, and Cognitive Exercises," *Clinics in Geriatric Medicine* 26, no. 1 (2010): 99–111, <https://doi.org/https://doi.org/10.1016/j.cger.2009.11.003>.

²² Mulyasa, *Manajemen PAUD* (Bandung: PT Remaja Rosdakarya, 2014).

²³ Donald B. Helms and Donald B. Helms, *Exploring Child Behavior* (New York: Holt Rinehart and Winston, 1983).

Because it is during this period that children can train their problem-solving and critical reasoning power from the beginning.

D. Conclusion

Based on the results of research that researchers did, in kindergarten, most children have been able to optimize cognitive development through Puzzle games by solving the problem from these Puzzle pieces into the appropriate shape. The child can also coordinate the eyes and hands to join the puzzle parts.

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