

The Role of Online Puzzle Games as Educational Tools for Children with Stunting Symptoms

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ABSTRACT

Stunting risks children's physical, mental, and cognitive development, leading to long-term impairments, significantly affecting their overall growth, learning abilities, and future potential. Online puzzle games allow children to practice concentration and hand-eye coordination through interactive challenges that stimulate children's creativity and memory. This study aims to assess the effect of educational online puzzle games on the development of preschool children with stunting symptoms. A pre-experimental design with a pretest-posttest approach was used, involving 52 children aged 3-6 years diagnosed with stunting symptoms. The children's development was measured using the Denver II screening tool. Data were processed using editing, coding, scoring, and tabulation, followed by crosstab statistical analysis. The results showed that 50% of respondents had abnormal development before playing the online puzzle game, while 65.4% had normal development afterwards. A significant improvement was observed, as indicated by the rejection of H₀, suggesting that online puzzle games positively affect the development of preschool children with stunting symptoms. The study concludes that online puzzle games can stimulate the development of children with stunting symptoms. It is recommended that families regularly provide educational games to enhance the development of children affected by stunting symptoms. Future research should consider larger sample sizes and explore the long-term effects of such interventions.

Keywords: Education Tools, Online Games, Puzzle, Stunting Symptoms, Children, Preschool



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1. INTRODUCTION

Stunting is a condition commonly found in developing countries, including Indonesia. According to Mustakim et al. (2022), this condition is related to chronic malnutrition in children. Stunting not only inhibits physical growth but also affects brain development. The impact of this condition ultimately affects children's cognitive and academic abilities. Children who experience symptoms of stunting face difficulties in concentration, memory, and social skills (Utami et al., 2024). These difficulties reduce their ability to follow the learning process optimally. Therefore, the government and society must take appropriate measures to support children's development.

Education plays a vital role in preventing and overcoming the impacts of stunting. According to Alotaibi (2024), an educational game-based approach can stimulate the development of children's cognitive, motor, social and emotional skills from an early age. Children with symptoms of stunting often experience developmental delays (Van Beekum et al., 2022). Therefore, stimulation through interactive education,

such as educational games, can help them catch up. Education involving activities stimulating brain and body coordination can improve children's thinking, problem-solving, and communication skills (Sutapa et al., 2021). Therefore, further discussion of the role of education in supporting children with stunting will provide broader and more relevant insights into this study.

One approach starting to be introduced in education is using educational games. These games are a fun learning tool while stimulating children's brain development. For example, according to Fathi & Mohammad (2024), puzzles are games that involve problem-solving, enhance logical thinking, and develop spatial and motor skills. This activity can improve children's cognitive abilities in an interactive and fun way (Asmawati, 2023). This is especially relevant for children who experience stunting. Games that stimulate mental development can help these children overcome obstacles in learning.

In addition, online puzzle games can improve children's focus and concentration (Shahmoradi et al., 2022). Children who are stunted have difficulty concentrating for long periods. Online puzzles offer challenges that can gradually improve attention span and problem-solving skills. This activity encourages children to work systematically and learn to complete increasingly complex tasks. Online puzzle game activities can help boost their self-confidence. Online puzzle games allow children to practice concentration and hand-eye coordination through interactive challenges that stimulate children's creativity and memory.

With the development of technology and various learning methods, games such as puzzles can be an effective tool in supporting the education of children with symptoms of stunting. According to Khadijah et al. (2022), the use of educational games not only provides entertainment but also equips children with cognitive skills. These skills are essential for their academic success and daily life. Innovation in education involving educational games has the potential to be one solution to overcome the challenges faced by children with symptoms of stunting.

In general, stunted children are at high risk of experiencing developmental disabilities, therefore appropriate treatment is needed. It is not uncommon for people to assume that the condition of a child's short height is a genetic factor and has nothing to do with health or nutritional problems. This opinion can trigger an increase in stunting rates due to a lack of parental knowledge about stunting, thus triggering an increase in stunting rates due to misperceptions (Shodikin et al., 2023). Genetic factors have little influence on a person's health compared to environmental factors and health services (Zhou et al., 2021). Usually stunting begins when a child is still in the womb and is visible when they enter the age of two. There are several symptoms of stunting, namely delayed body and tooth growth, poor learning ability and memory, and a lighter weight for children of the same age. This is a problem for the future (Bagamian et al., 2023). The developmental delays that are seen in children include slow personal social development, adaptive-fine motor skills, gross motor skills and language (Mulyaningsih et al., 2021). Therefore, stimulation with educational puzzle games is believed to be able to overcome the problem of developmental disorders.

The World Health Organization (WHO) recorded the prevalence of toddlers experiencing nutritional problems in 2020 as many as 233.5 million. The prevalence of stunting in toddlers was 149.2 million or 22%, the prevalence of malnutrition was 6.7% with a total of 45.5 million toddlers, and 38.9 million or 5.7% were overweight. WHO also determined five sub-regions of Stunting prevalence, namely Oceania (41.4%), Africa (30.7%), Asia (21.8%), America (11.3%), and Europe (4.5%) (UNICEF et al., 2023). Asia has a large percentage and number of the world's stunting problems with a total of 79 million toddlers. WHO also stated that 53% of toddlers who suffer from stunting live in developing countries, one of which is Indonesia. Based on the 2021 Indonesian Nutritional Status Study (SSGI), it was found that 24.4% of toddlers experience stunting problems. The province with the highest percentage of stunting is East Nusa Tenggara, which is 37.8%. Meanwhile, East Java is ranked 21st at 23.5% (Kementerian Kesehatan RI, 2020). Based on the results of the Indonesian Nutritional Status Study (SSGI), in 2021 there were 23.5% of toddlers who experienced stunting in East Java Province. There are 14 districts/cities in East Java with a prevalence of stunted toddlers above the provincial figure. Currently, the stunting rate in Bojonegoro Regency is the second lowest in East Java after Surabaya City. The highest stunting incident data based on the health profile of Bojonegoro Regency is the Balen Health Center with 432 cases (10.5%) and the second is the Ngasem Health Center with 261 cases (7.1%). Based on initial survey data at the Balen Health Center, stunting data was obtained as many as 105 cases (2.77%) (Health Department Regency Bojonegoro, 2022).

The impacts caused by stunting according to WHO consist of short-term and long-term impacts. The short-term impacts of stunting are increased mortality and morbidity, impaired growth and muscle mass, and body composition and brain development (Ghosh et al., 2020). Long-term impacts include impaired physical, mental and intellectual growth of children which are permanent (Upadhyay et al., 2022). To reduce the short-term and long-term impacts, physical exercise is needed, namely games that can control the development and growth of children. Aspects of pre-school child development that must be considered are cognitive, language, motor, social emotional development, and so on. One example of cognitive development that must be developed in pre-school children is general knowledge such as recognizing numbers, letters, shapes, names of animals, fruits and others (Brou et al., 2023). Meanwhile, language development that must be developed by pre-school children is understanding and being able to do something according to instructions. In addition, motor development should also be developed, for example walking, running, jumping, writing, drawing, cutting, throwing and catching balls, and so on. All of these

aspects can be found in the "Puzzle" game which can develop cognitive aspects such as sharpening children's thought patterns by counting the number of pictures, fine motor aspects by pointing at the pictures found, gross motor aspects by walking and running, social emotional aspects by interacting and working together with friends, language aspects by how children understand commands, and moral aspects by caring about fellow friends (Wardani, 2022).

In addition to games, other efforts that can be made to reduce the prevalence of stunting include monitoring toddler growth, organizing additional food or MP-ASI activities, organizing early stimulation of child development, and providing optimal health services (Vaivada et al., 2020). Prevention and health promotion are focused on addressing direct and indirect causes of stunting, one of which is by using health education media (Soviyati et al., 2023). Several researchers have researched puzzle games and child development. Research by Mu'min & Yultas (2020) states that 75% of normal kindergarten children can develop through playing puzzles. This game can sharpen children's brains, train reasoning, and improve problem-solving skills. Research by Nurwita (2019) stated puzzle-making activities help children develop eye-hand coordination to improve fine motor skills in preschool-age children. Research by Sandat & Wedayanthi (2024) shows that completing puzzles teaches children to be patient and persistent, because they need to match the pieces to form a complete picture, an observation of 44 normal kindergarten children. Research by Sit et al. (2024) shows that puzzle games can be used as a learning medium to hone the visual-spatial intelligence of normal children, helping them understand the relationship between parts and the whole. Research by Nurussakinah & Romadona (2023) shows that puzzle games can help children learn to cooperate, communicate, and support each other, which contributes to developing their social skills in children with symptoms of emotional instability. The respondents of previous studies were normal children and children with symptoms of emotional instability. Novelty respondents of this study are children with symptoms of stunting. This study aims to assess the effect of educational online puzzle games on the development of preschool children with stunting symptoms.

2. METHOD

The design of this study is pre-experimental research design with a pretest-posttest. The design in this study aims to determine the effect of online puzzle games on the development of pre-school children with stunting symptoms in the Bojonegoro area. The study was conducted at the integrated health post in the Balen Health Center working area, Indonesia. The sample was some pre-school children with stunting symptoms aged 3-6 years in the Balen Health Center working area, Bojonegoro Regency in 2022-2023, totaling 52 children obtained using the simple purposive sampling technique. The criteria for purposive sampling were poor health history and inhibited cognition. The implementation of 2022-2023 was carried out in stages starting from preparation by providing informed consent to parents, intervention to evaluation. The intervention of online puzzle games was implemented at different times and places until 52 children were collected.

The variables in the study consisted of independent variables, namely online puzzle games and dependent variables, namely child development. The instrument in this study used observation measurements with the Denver II test. Denver II is a tool used to measure the development of children from 0 to 6 years of age (Christovão et al., 2023), with the aim of identifying developmental delays in various aspects. This instrument measures four main domains of child development: 1) Cognitive: Measuring the ability to think, understand, and solve problems. 2) Gross Motor: Measuring the child's ability to perform large movements such as walking, running, jumping, and body coordination. 3) Fine Motor: Measuring the child's skills in using hands and fingers, such as drawing, holding small objects, or stacking blocks. 4) Language: Measuring the child's ability to speak and understand words and verbal and non-verbal communication skills. 5) Personal-Social: Measuring the child's ability to interact with others and understand and manage emotions.

Null hypothesis (H₀): online puzzle games do not positively affect the development of children with stunting symptoms. Alternative hypothesis (H_a): online puzzle games positively affect the development of children with stunting symptoms. The data analysis technique for hypothesis testing used the Chi-Square test. Evaluate the hypothesis by comparing the p-value obtained with a significance level 0.05.

3. RESULTS AND DISCUSSION

3.1. Results

Table 1 shows the distribution of preschool children's development with symptoms before and after playing online puzzles. Of the total 52 children observed, before playing online puzzles, 26 children (50.0%) had normal development, while 12 children (23.1%) had abnormal development, and 14 children (26.9%) were in the doubtful category. After playing online puzzles, the number of children with normal development increased to 34 children (65.4%), indicating an improvement in their development. Meanwhile, the number of children with abnormal development remained the same, namely 12 children (23.1%), indicating that playing online puzzles had no significant impact on this group. However, the

number of children in the doubtful category decreased from 14 children (26.9%) to 6 children (11.5%), indicating that some children experienced developmental improvements after playing online puzzles. Overall, these data indicate that playing puzzles can have a positive impact on the development of preschool children, especially those in the doubtful category, by encouraging them to develop more normally.

Table 1. Distribution of Development of Preschool Children with Symptoms Before and After Playing Online Puzzle Games

No.	Development	Before		After	
		Frequency	Percentage (%)	Frequency	Percentage (%)
1.	Normal	26	50.0	34	65.4
2.	Abnormal	12	23.1	12	23.1
3.	Doubtful	14	26.9	6	11.5
	Total	52	100.0	52	100.0

Table 2 shows a cross-tabulation of the effect of puzzle games on the development of preschool children with symptoms of stunting. These data illustrate the relationship between puzzle play and changes in children's development, helping to understand whether the activity positively impacts their development despite stunting.

Table 2. Cross Tabulation of Effect of Online Puzzle Games on Pre-School Children's Development with Stunting Symptoms

No.	Development	Development						P-Value
		Normal		Abnormal		Doubtful		
		F	%	F	%	F	%	
1.	Before	26	50	12	23.1	14	26.9	0.000
2.	After	34	65.4	12	23.1	6	11.5	

Table 2 compares preschool children's development before and after playing puzzles, with a P-value of 0.000 indicating the statistical significance of the Chi-Square test. The value is less than 0.05, indicating that the null hypothesis is rejected. The study's results suggest that online puzzle games positively affect the development of preschool children with stunting symptoms.

3.2. Discussion

3.2.1. Development of Pre-School Children with Stunting Symptoms Before Playing Online Puzzle

Based on the Table 1 obtained, it shows that before playing online puzzle games, there were some respondents with normal development, namely 26 respondents (50.0%). Factors that influence development in preschool children include family factors and factors outside the family. In family factors, relationships with parents and siblings will help children be more open in interacting and foster a sense of affection (Fargas-Malet & McSherry, 2021). Supported by good communication so that children find it easier to get to know their surroundings. The order of the child's position will affect the child's level of independence. The youngest child tends to always depend on parents and siblings. Families with few children tend to devote more optimal affection, attention and time in all forms of activities. Families that are not rude and caring for each other will have a good effect on the child's development stage. Busy mothers tend not to have time to care for their children so that children's development is sometimes not monitored optimally (Knobl et al., 2022). This is different from mothers who take care of all their needs and always monitor their children's development. While in factors outside the family, it is explained that relationships with peers of the same age will affect their development (Kucaba & Monks, 2022). A play environment is needed that can have a positive impact on children (Graber et al., 2021). Interacting with peers naturally is usually a sign of good social development. Children interact with others without hesitation and socialize well.

Stunting has biological implications for brain and neurological development which translates into decreased cognitive values (Daracantika et al., 2021). Severe stunting with a Z-score $< -3SD$ of the child's length or height-for-age index has a negative impact on the child's development. In addition, children who experience stunting in the first 2 years of life are likely to have a non-verbal IQ below 89 and an IQ 4.57 times lower than the IQ of children who are not stunted (Nazidah et al., 2022). According to Mustakim et al. (2022), stunting affects the language and personal social development of toddlers. Stunting can cause language development disorders in children (Nahar et al., 2020). This is because stunting is a manifestation of a lack of nutritional intake over a long period of time (Petri et al., 2024). So that the development of brain cells can be hampered. This will certainly inhibit the growth process of axons and dendrites, synapse formation and myelination processes, which greatly affect the acceleration of nerve impulses from one brain cell to another. Nutrients that can affect the brain development process include protein, energy, essential fatty acids and micronutrients such as zinc, iron, vitamin B and iodine. The part of the brain that may be affected in growth and development is the left hemisphere of the brain in the Broca area and the

Wernicle area which regulates speech and language abilities. Children who experience a lack of nutritious food tend to be weak and inactive, resulting in decreased interaction with their environment and causing poor development, marked by decreased activity, being more fussy and unhappy, and not showing much curiosity (Gusnedi et al., 2023). This can hinder children from developing their potential to adapt to their social environment.

Factors that influence the development of early childhood are heredity, environment, pregnancy conditions, childbirth complications, nutritional fulfillment, health care, susceptibility to disease (Scattolin et al., 2022; Widayati et al., 2021). In this study, the factors that influence the development of stunted children are health care factors. Health care factors affect the development of toddlers, because health care is not routinely carried out by families and health workers, toddlers cannot be monitored for deviations in their growth and development. Several respondents reasoned that the distance between home and health services was far, there were no vehicles, their children were not sick so they thought that if they were not sick they did not need to get health care. At the time of the integrated health post, these mothers should routinely take their children to the integrated health post/health center if they cannot do it according to the integrated health post schedule, then it is better for mothers to take the time to check their children's health condition (Vaivada et al., 2020).

3.2.2. Development of Pre-School Children with Stunting Symptoms After Playing Online Puzzle

Based on the Table 1 obtained, it shows that after playing the online puzzle game, there were more than half of the respondents with normal development, namely 34 respondents (65.4%). According to Xiong et al. (2022) and Lamrani & Abdelwahed (2020), games can improve the quality of children's learning, namely in cognitive abilities. To produce the self of early childhood at the preoperational stage where children show the world with words, imagination, and pictures, therefore playing as a learning medium that can include learning values. According to Kim & Lee (2021), the purpose of the game method in children is to train the right brain's ability to remember and concentrate on pictures and words in the game. Games in children are used as a learning medium aimed at improving the development of early childhood because games can help children express perceptions, memories, thoughts, symbols, reasoning, and problem solving from messages or meanings in the pictures in the game.

Based on the results of observations after the provision of online puzzle game action, it is known that there is progress in child development, where more than half of the respondents have normal development. Before the online puzzle game was played, there were 36 children with normal development and after the online puzzle game was played, there were 32 children with normal development. Then before the puzzle game was played, there were 24 children with questionable development and after the online puzzle game was played, there were only 6 children with questionable development. This shows that there is an influence of the online puzzle game on the development of pre-school children with stunting symptoms.

Child development can develop well if it gets the right stimuli, so media is needed to stimulate child development. Media to stimulate needs to be designed so that the focus on child development occurs continuously. Cognitive development stimulation will not be felt by children because it is done through play activities. Educational puzzle games are suitable for use by early childhood children because their attractive forms are adapted to the theme of the learning material (Broadbent et al., 2022).

Children need to get an environment that stimulates brain growth and always get developmental stimulation. Stimulation can be given easily, one way is by inviting children to play. Stimulation is very helpful in stimulating the brain to produce hormones needed in its development. Stimulation can be given in various forms of simple and easy to do games (Mallawaarachchi et al., 2024). From an early age, parents should be able to provide developmental stimulation, namely by inviting children to play educational online puzzle games.

3.2.3. The Effect of Online Puzzle Games on the Development of Children with Stunting Symptoms

Based on the Table 1 obtained, it shows that before the online puzzle game was played, there were some respondents with normal development, namely 26 respondents (50.0%) and after the puzzle game was played, there were more than some respondents with normal development, namely 34 respondents (65.4%). This shows that there is an effect of puzzle games on the development of pre-school stunting children. The impacts caused by stunting according to WHO consist of short-term and long-term impacts. The short-term impacts of stunting in the health sector include increased mortality and morbidity, impaired growth and muscle mass, and body composition and brain development (Santos et al., 2020). Long-term impacts include impaired physical, mental and intellectual growth of children which are permanent. To reduce the short-term and long-term impacts, physical exercise is needed in the form of games that can control child development, puzzle games which can develop cognitive aspects such as sharpening children's thinking patterns by counting the number of pictures, fine motor aspects by taking pictures found, gross motor aspects by walking and running, social emotional aspects by interacting and working together with

their group, language aspects by children understanding commands, art aspects by singing, and moral aspects by caring for fellow friends.

Based on Table 2 of the final data analysis using cross tabulation, it is known that in the observation with the Denver Development Screening Test before the online puzzle games (pre-test) there were some respondents with normal development and in the (post-test) there was a difference in results, namely that more than half became normal. This is because the frequency of giving online puzzle games is routine every day, namely for one month. If developmental stimulation with games can be done routinely every day, of course it will provide results in the form of an increase in child development (Alotaibi, 2024).

Based on Table 2, statistical hypothesis testing shows that online puzzle games positively affect the development of preschool children with stunting symptoms. The results of this study are in line with research that there is an influence of online puzzle games on children's cognitive development. Children will grow and develop optimally based on the benefits of playing (Dag et al., 2021). In addition to cognitive development, five aspects of development will be stimulated by playing online games. Cognitive intelligence aspects: 1) Children's ability to make plans in the game; 2) Children's ability to solve difficulties in the game; 3) Children's ability to recognize differences based on size; 4) Children's ability to recognize the shape and size of the game; 5) Children's ability to match each piece of physical motor skills, social aspects, emotional aspects, and language aspects. Playing teaches children how to solve problems, improve memory, and focus on an activity (Zhang et al., 2022).

The results of this study are supported by Putri (2022), who showed that flashcard games influence cognitive development in preschool children. Flashcard games use a series of picture cards with a card size of 8x12 cm and cards with red block writing to attract children's attention with a size of 25x30 cm; this game is played by showing pictures to children for approximately 1 second. Learning using flash cards can improve cognitive development in preschool children, because flash card games are a method of learning while playing, meaning that using this method can attract children's attention and children can concentrate better. Games for early childhood will impact their growth and development; some games can stimulate all aspects of child development, starting from gross motor development, language, fine motor skills and personal social (Broadbent et al., 2022). This aligns with the theory explained by experts that playing is very important for children's growth and development. Playing must be done on the child's initiative and the child's own decision. Playing must be done with pleasure so that all fun play activities will produce a good learning process in children.

4. CONCLUSION

The online puzzle games can support the development of children aged 3-6 years who experience symptoms of stunting. Educational activities in online puzzle games have provided stimulation that can help improve children's cognitive, fine motor, and problem-solving skills. Online puzzle games have improved concentration, perseverance and hand-eye coordination to support the mental and physical development of children with symptoms of stunting. Online puzzle games have an essential role as an educational tool for children with symptoms of stunting. Children with symptoms of stunting can develop cognitive skills, memory, and problem solving, which help improve learning abilities. In addition, online puzzle games have provided a fun learning experience for children with symptoms of stunting.

The limitations of this study are the limited sample size to a specific group of children and the short duration of the intervention. Further research with a broader sample size and longer duration is needed to gain a deeper understanding of the effect of online puzzle games on children with stunting symptoms. The contribution of this study is to provide evidence that educational games, such as puzzles, can be used as an alternative method to support the growth and development of children with stunting symptoms while also providing new insights for educators and parents in choosing activities that can support child development. Parents should be able to stimulate their children's development by providing both modified and existing educational games. Health workers can provide health promotion routinely and periodically for parents of preschool children. This health promotion is related to stimulation for child development. With this health promotion, it is hoped to increase parents' knowledge regarding stimulation for child development.

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CONFLICT OF INTEREST

The authors declares that they have no conflict of interest.

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