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The Effect of Using Busy Box Creative Little Scientists on Critical Thinking Skills of 5-6 Year Old Children

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Abstract: The Effect of Using Busy Box Creative Little Scientists on Critical Thinking Skills of 5-6 Year Old Children. Objectives: This study aims to determine the effect of using the Busy Box Creative Little Scientists learning media in the learning process on the critical thinking skills of children aged 5-6 years. **Methods:** This quasi-experimental study involved 21 students aged 5-6 years, divided into two classes: a control class and an experimental class. Students were selected by purposive sampling. The experimental class used the Busy Box Creative Little Scientists learning media, while the control class did not. Critical thinking skills were measured before and after the intervention, and the N Gain was calculated to compare the improvement. **Findings:** The results showed a significant difference in the critical thinking skills of children between the experimental and control classes. The experimental class showed an N Gain of 64%, while the control class had an N Gain of 44%. **Conclusion:** The study highlights the effectiveness of Busy Box Creative Little Scientists in improving the critical thinking skills of children aged 5-6 years. These findings support further exploration into the use of interactive learning media for enhancing critical thinking in early childhood education.

Keywords: learning media, critical thinking skills, early childhood.

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INTRODUCTION

In the 21st century, critical thinking skills are one of the abilities that must be possessed by every individual, because their role is very important and even considered urgent as the main goal of education in Indonesia. However, on the other hand, the development of critical thinking skills is hampered by current conditions (Atiyah, Miarsyah, & Sigit, 2020). Critical thinking can be defined as the ability to understand a concept, synthesize, apply, and evaluate certain information (Dekker, 2020; Florea & Hurjui, 2015). Critical thinking skills also include skills in conducting a critical analysis of a matter, making a logical conclusion, and expressing one's own opinion (Bað & Gürsoy, 2021). According to Bliss (2019), revealed that not only adults can develop their critical thinking skills, children can also show the development of critical thinking from an early age (Fernández-Santín & Feliu-Torruella, 2020). Critical thinking skills in early childhood have emerged naturally when children begin to have curiosity about the objects around them. In children, critical thinking indicators can be characterized by children being able to observe, analyze, form hypotheses, draw a conclusion based on facts, and communicate with others (Santn & Torruella, 2017).

The results of observations at the UPI Cibiru Laboratory Kindergarten, show that critical

thinking skills in early childhood are still quite low and have not developed optimally. In fact, in some PAUD institutions, the problem was found that the learning carried out still focuses on memorization and one-way delivery of material. The approach used tends to be traditional, more formal, and focused on providing information directly to children without much attention to the development of critical thinking and creative exploration. Children are often asked to complete written assignments in class or memorize material without being given a deep understanding. This less interactive learning approach results in most children being less active in asking questions or identifying new things. In fact, some children appear to be passive and less enthusiastic in participating in the learning process. In addition, limited facilities and interactive learning media are also the main challenges that limit the potential development of children's critical thinking skills. In fact, according to Van Laar, Van Deursen, Van Dijk, & De Haan (2020), conventional learning methods are no longer effective in the 21st century era, where education currently requires the use of interactive media and technology in every learning activity.

Early childhood actually requires an interactive learning environment, where they can actively participate, ask questions, and understand concepts through interesting and immersive activities. Therefore, a more interactive learning approach is needed to support the optimal development of critical thinking skills. According to Wang, Leung, & Jiang (2021), critical thinking can be stimulated through interactive activities, where children can play and interact with their environment. Therefore, the problems that exist in the field make researchers interested in conducting research by testing the implementation of the use of interactive learning media for children at the UPI Cibiru Laboratory Kindergarten, especially for children aged 5-6 years to determine the effect on their critical thinking skills. The media that will be used in this study as a solution to existing problems by overcoming the weaknesses of traditional and conventional learning approaches in the form of an interactive box called busy box creative little scientists.

Busy box creative little scientists is a learning media designed by adopting a variety of games packed in an interactive box measuring 40 cm x 40 cm. In the box there are four games with different themes. The selection of themes in the busy box creative little scientist media refers to the seven scopes of science learning, including: 1) science as inquiry; 2) physical science; 3) life science; 4) earth and space science; 5) science and technology; 6) science in personal and social perspective; 7) history and nature of science standards (Marian & Jackson, 2020). The "Getting to Know Animals and Plants" theme teaches the sequence of metamorphosis through magnetized images, while "I Care for the Environment" uses a snakes and ladders game to teach cause-and-effect relationships to the environment. "Exploring Earth and Space" introduces planets and celestial bodies with a giant puzzle cube, while 'Technology Around Us' explores the colors of the rainbow using the Magic Rainbow Box. Each game encourages children to ask questions, observe, collaborate and draw conclusions, while introducing important concepts in a fun way.

The importance of an interactive learning approach to stimulate critical thinking skills in children is supported by previous research. According to Mao, Cui, Chiu, & Lei (2022), said that an interactive learning approach through games can lead to active student involvement, which encourages critical thinking, analyzing information, evaluating, and making the right decisions. This is also reinforced by the United Nations Children's Fund, which states that to support early childhood learning, play activities are one of the most appropriate methods. The learning process using the science, environment,

technology, and society (SETS) approach is also effective in improving students' critical thinking skills and understanding. Likewise, the use of technology and problem-oriented teaching methods proposed in the SETS approach has been shown to develop children's critical thinking skills (Astuti, & Juriani, 2019; Tytler, 2020).

The problem raised in this research is the low critical thinking skills of early childhood, especially in the age range of 5-6 years in several PAUD institutions that still use traditional and conventional learning approaches. Busy Box Creative Little Scientists is expected to provide a solution to this problem by providing a more interactive learning environment that supports the development of children's critical thinking effectively. Several previous studies have also shown that interactive learning media contribute positively to the development of critical thinking skills in early childhood, so Busy Box Creative Little Scientists is expected to be a significant innovation in ECD learning media. Thus, this research can provide an empirical basis for the development and policy of more effective education in PAUD, in accordance with the needs of child development in an increasingly competitive era of globalization.

METHOD

Participants

This research was conducted at UPI Cibiru Laboratory Kindergarten involving 21 group B students aged 5-6 years. The students were divided into two classes, namely an experimental class of 10 children and a control class of 11 children. The sampling technique used was saturated sampling, in which all 21 group B students were used as research samples. Thus, the population in this study were all group B students at UPI Cibiru Laboratory Kindergarten, while the sample was all members of the population. The characteristics of the participants include a uniform age range, namely 5-6 years, as well as a level of cognitive development that is in accordance with the age group, so that the relevance of the research results is expected to represent the development of critical thinking skills of children in that age range.

Table 1. Basic information on research subjects

Basic Information	Group	Experimental Group (n=10)		Control Group (n=11)	
		Number of People	Effective Percentage	Number of People	Effective Percentage
Gender	Male	5	50%	10	91%
	Female	5	50%	1	9%

Research Design and Procedures

This study used a quasi-experimental method with a quantitative approach to test the effect of Busy Box Creative Little Scientists media on critical thinking skills of children aged 5-6 years. The research design used was a non-equivalent control group design, in which the experimental group received learning with interactive Busy Box media, while the control group used food and beverage classification board media. This research took place over two months, from April to May 2024. In the preparation stage, researchers set objectives and formulated problems, as well as compiled observation instruments based on critical thinking indicators according to Watson Glasser's theory adapted to early childhood development. The instrument was then tested for validity and reliability to ensure the accuracy of measuring children's critical thinking skills.

In the implementation stage, researchers conducted a pretest to measure the initial critical thinking skills of both groups before learning began. Next, the experimental group participated in learning by using Busy Box, which consists of various games with a science learning approach designed to stimulate critical thinking skills. Each game theme in Busy Box gives children the opportunity to question, observe and draw conclusions based on their experiences. The first theme, "Let's Get to Know Animals and Plants," uses magnetic images to teach the sequence of animal and plant metamorphosis, honing children's ability to recognize assumptions, evaluate arguments, and deduce. The second theme, "I Care for the Environment," is a modified snakes and ladders game that teaches the cause-and-effect relationship of actions on the environment, helping children think about the positive and negative impacts of certain actions and relate them to real situations. The third theme, "Exploring Earth and Space," uses puzzle cubes and information cards to introduce planets and celestial bodies, encouraging children to think critically about the differences between celestial bodies and deduce the characteristics of each. The final theme, "Technology Around Us," uses the Magic Rainbow Box to explore the colors of the rainbow through a variety of light-up and colored lights, teaching children how colors are produced and to distinguish between natural and artificial colors. All of these games are designed to develop children's critical thinking skills in a fun and developmentally appropriate way. The control class used a food and beverage classification board, where children were asked to categorize which pictures belonged to food or beverages.

After the implementation, a posttest was conducted to measure changes in critical thinking skills in both groups. Thus, this study not only tested the effect of Busy Box media on critical thinking skills, but also provided insight into the effectiveness of game-based media in early childhood learning. The use of Busy Box was chosen due to its interactive and contextual approach, allowing children to learn actively, exploratively, and playfully, while developing critical thinking skills early on.

Instrument

The instrument used in this study is an observation sheet to assess the critical thinking skills of children aged 5-6 years in the pre-test and post-test, which is adapted from Watson Glaser's theory of critical thinking stages. This theory has been developed into three main dimensions: 1) recognizing assumptions; 2) evaluating arguments; and 3) drawing conclusions, which are further elaborated into five indicators: 1) assumptions; 2) analyzing arguments; 3) deduction; 4) interpreting information; and 5) conclusions (Fitriani & Vinayastri, 2022). To ensure the accuracy of the instrument, its validity and reliability were tested through evaluations from three exSperts, namely a material expert, a media expert, and a practitioner from among kindergarten teachers who acted as validators.

The validity test results using the Content Validity Index (CVI) showed a value of 0.89, which is classified as valid. In addition, the instrument also showed good reliability, with a Cronbach's Alpha coefficient of 0.75. In this case, a valid and reliable instrument can be considered an effective measurement tool in the learning process (Biasutti & Frate, 2018). The assessment categories of children's critical thinking skills include four levels: not yet developing, starting to develop, developing as expected, and developing very well.

Data Analysis

Data analysis was conducted to measure the increase in critical thinking skills of children aged 5-6 years before and after the intervention. First, pre-test and post-test data were analyzed

with normality test and homogeneity test as prerequisites, then calculated using the N-Gain formula to see changes in critical thinking skills. Furthermore, significant differences between the control class without Busy Box Creative Little Scientists media and the experimental class with the media were analyzed using the independent sample t-test through SPSS version 29 software.

■ RESULT AND DISCUSSION

This study measures the critical thinking skills of children aged 5-6 years by using pre and post tests through observation. The pre test was conducted to measure children's critical thinking skills before the learning process, while the post test was conducted to measure children's critical thinking skills after the learning material was given. In the experimental class, learning was carried out using busy box creative little scientists media, while in the control class learning was carried out food and beverage classification board media.

Busy box creative little scientists is a learning media that has a variety of games that can be played by children, without reducing the content of the material to be conveyed. The following are the pre-test and post-test results of children's critical thinking skills in the experimental and control classes.

Table 2. Pre-test and post-test results in experimental and control groups

Experimental Group			Control Group		
Name Anonymization	**Pre-test**	**Post-test**	**Name Anonymization**	**Pre-test**	**Post-test**
QAS	6	15	GTK	6	11
NSA	9	14	RMZK	9	14
HA	11	18	RMSR	8	13
KRH	6	14	PGS	6	11
HHR	7	15	RPAH	8	14
AGRM	9	17	HAI	9	16
DAA	10	18	KAI	7	12
KAK	11	17	GZA	12	17
RKG	11	17	SN	10	15
LAMA	6	13	MRW	6	11
			MAN	9	12

Table 2 shows a significant difference between the pre-test and post-test scores of children's critical thinking skills in the experimental class that used the busy box creative little scientists and the control class that did not use the media. The maximum score that can be obtained by each child is 20 points, which reflects five indicators of critical thinking skills of children aged 5-6 years. Each assessment indicator gets a maximum point of four, which indicates that children's critical thinking skills have reached a very well-developed stage.

The busy box creative little scientists media has four games that can stimulate critical thinking skills in early childhood, which consist of: 1) The theme Let's Get to Know Animals and Plants, where children are trained to understand the stages of metamorphosis of animals and plants through sequential image arrangement games, which facilitate the development of skills to recognize assumptions; 2) The theme I Care for the Environment, introduces children to a snakes and ladders game that teaches cause-and-effect relationships, helps them evaluate choices and

understand the impact of each action on the environment; 3) The Exploring Earth and Space theme provides an experience of observing celestial bodies through cube puzzles and information cards, which hones children's skills in drawing conclusions based on observations; and 4) The Technology Around Us theme uses a magic rainbow box to invite children to explore the colors of the rainbow and the effects of color mixing, which supports the development of deduction skills.

Overall, the data showed that children in the experimental class using the Busy Box benefited more in developing critical thinking skills, compared to children in the control class who did not use the learning media. The richer and more interactive learning experience in the Busy Box helped children to build critical thinking skills that are applicable and relevant to everyday life through a science learning approach.

The normality test results in Table 3, show that the Sig. value of the Shapiro-Wilk test for the experimental group is 0.852, a value of 0.852 e" á = 0.05 which indicates that the experimental group with the use of busy box creative little scientist media is normally distributed. Likewise, with the control class whose learning uses the food and beverage classification board media, the Sig. value of the Shapiro-Wilk test is 0.372, a value of 0.372 e" á = 0.05 indicating that the data is normally distributed.

Table 3. Normality test results for the experimental and control groups

Group	Test of Normality (Shapiro-Wilk)	
	Sig.	Description
Experimental	0.852	The data is normally distributed
Control	0.372	The data is normally distributed

Based on the homogeneity test of variance using the Levene Test as in Table 4, it is known that the Sig. value is 0.820. Sig value. 0.820 e" á = 0.05 which indicates that all data groups in this study have homogeneous variants. So, based on the results of the normality test and homogeneity of variance test, the data from the experimental class and control class came from a normally distributed population and had homogeneous variants.

Table 4. Variance homogeneity test results (critical thinking in early childhood)

Levene Statistic	df1	df2	Sig.	Description
0.053	1	19	0.820	Homogeneous Data

From Table 5, it can be seen that the average N-Gain value for the experimental class using the busy box creative little scientist media of 0.64 is

Table 5. N-Gain test results in experimental and control groups

Group	N-Gain	Category	N-Gain (%)	Category
Pre-test Control Group	0.44	Moderate	44%	Less effective
Post-test Control Group				
Pre-test Experimental Group	0.64	Moderate	64%	Sufficiently effective
Post-test Experimental Group				

included in the medium category, with an N-Gain per cent of 64% which is included in the moderately effective category. Meanwhile, the average N-Gain value for the control class using the food and beverage classification board media of 0.44 is included in the moderate category, with an N-Gain percent of 44% which is included in the less effective category.

Table 6. Independent samples test

T-test for Equality of Means					
t	df	Significance		Mean Difference	Std. Error Difference
		One-Sided p	Two-Sided p		
4.036	19	0.000	0.001	20.03193	4.96382

Table 7. Improvement in critical thinking skills of children in the experimental class: pre-test and post-test results

Critical Thinking Skills Indicators	Pre-Test Total	Post-Test Total	Percentage Increase
Assumptions	15	31	106.7%
Analyzing Arguments	18	33	83.3%
Deduction	17	34	100.0%
Interpreting Information	16	35	118.8%
Inference	19	37	94.7%

The results of the Independent Samples Test in Table 6, show that the two-sided p significance (sig.) value for the busy box creative little scientist learning media is 0.001, which means that the value of 0.001 d" á = 0.05. This indicates a significant difference in children's critical thinking skills between the experimental class that used the busy box creative little scientist learning media and the control class that did not use it.

In Table 7, the increase in critical thinking skills of children aged 5-6 years is seen in each indicator measured. In the Recognizing Assumptions indicator, children experienced an increase of 106.7%, indicating that children were better able to identify the assumptions underlying a statement or argument after using Busy Box. The Analyzing Arguments indicator showed an improvement of 83.3%, which means children became better at evaluating and analyzing arguments they heard or read, thanks to the learning facilitated through the game in Busy Box. For Deduction, children showed a 100% improvement, meaning they are better able to draw logical conclusions from given information. The Ability to Interpret Information increased rapidly by 118.8% compared to other indicators, indicating that children became more skilled in understanding and interpreting the information they obtained through various games contained in the busy box, such as puzzles or information cards. Finally, in the Conclusion indicator, there was an increase of 94.7%, indicating that children were better able to draw or make appropriate conclusions based on the observations and information they received.

Overall, this significant increase in all indicators of critical thinking skills shows that the Busy Box Creative Little Scientist learning media is effective in stimulating the development of critical thinking skills in children aged 5-6 years. Through games designed to introduce science concepts in an interactive way, children become more interested in learning and can more easily

build analytical and reflective skills, which are important for their cognitive development.

The interactive features of Busy Box Creative Little Scientists can increase children's interest in learning and active involvement in the learning process. For example, in the game of recognizing rainbow colors and knowing color mixing through a magic box containing lights, which when pressed will appear various colors. In this magic box game, many children are interested in trying it which indicates their enthusiasm. Interactive technology introduced to students can attract interest and stimulate their intrinsic motivation to learn (Duncan, 2020; Marougkas, Troussas, Krouska, & Sgouropoulou, 2023). In addition, in the cube puzzle game, where children can feel the sensation of playing a three-dimensional puzzle in the form of a cube, the puzzle can be used by children to arrange pictures of celestial bodies and planets correctly according to the available cards, this game also attracts children's attention, where children want to try until all the pictures can be arranged, and finally children can ask questions because of their high curiosity, and children dare to tell about their knowledge related to celestial bodies and planets. This clearly indicates that game-based learning can increase motivation in learning (Deta et al., 2021; Lutfi, Aftinia, & Permani, 2023). The utilization of game-based teaching methods is not only proven to increase motivation in learning, but can also improve various student abilities (Byusa, Kampire, & Mwesigye, 2022).

Choiriyah's research (2022), found that multimedia-based learning for distance learning used during the COVID-19 pandemic was effective in developing critical thinking skills in early childhood. These results are in line with the findings on the Busy Box Creative Little Scientists media, which is also effective in improving the critical thinking skills of children aged 5-6 years through interactive games. Although the form is different, where busy box is based on physical games, while the other uses digital multimedia. However, both show that interactive media can be an effective tool in stimulating and developing children's critical thinking skills from an early age, providing flexibility in interactive learning approaches.

Although Busy Box Creative Little Scientists is effective in improving critical thinking skills of 5-6 year old children through various interactive games, it has some limitations. Its primary focus on developing cognitive skills such as critical thinking may be less than optimal in building social-emotional skills or creativity. In addition, it may be less effective for children with more kinesthetic learning preferences or who require direct interaction with the natural environment. However, continued use of the Busy Box can have a positive long-term impact, by forming a strong foundation of critical thinking in children. Children who habitually use this medium will develop analytical skills that can improve their readiness to face future academic and social challenges.

■ CONCLUSION

The results showed that the use of Busy Box Creative Little Scientist media is effective in improving the critical thinking skills of children aged 5-6 years, with a more interactive and safe approach compared to conventional learning tools. However, this study has several limitations; among them is the limited sample size, which results in the results not being generalizable to a wider population. The short duration of the study also makes it difficult to assess the long-term impact of using this media, as well as not considering other variables that may affect the development of children's critical thinking skills. Therefore, it is recommended that early childhood education institutions consider providing Busy Box Creative Little Scientist interactive media as an alternative to improve children's critical thinking skills. The use of this media should be

done with an optimal frequency, namely four meetings, to maximize effectiveness, considering that there are four games with different themes in it. For future research, it is recommended to use a larger sample size, a longer duration of research, and conduct comparisons with other types of interactive media. This is expected to provide a more comprehensive insight into the impact of educational games on the development of critical thinking in early childhood.

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