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The Effect of Using Smart Fruit Pocket Promotional Tools on Understanding of Basic Mathematics and Science Concepts in Early Childhood in Ar-Rohman Paud, Aek Marian Village, Lembah Sorik Marapi District

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ABSTRACT

This study aims to determine the effect of using the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood at the AR-Rohman Early Childhood Education Center (PAUD) in Aek Marian Village, Lembah Sorik Marapi District. This study used a quantitative approach with a Pre-Experimental Design using a One-Group Pretest-Posttest Design. The population and sample in this study were all 30 children in Group B of the AR-Rohman PAUD, using a total sampling technique. The research instrument was an observation sheet consisting of 10 indicators of understanding basic mathematics and science concepts. Data were analyzed using validity tests, reliability tests, normality tests, and simple linear regression tests using SPSS. The results of the simple linear regression test showed a significance value of 0.002 ($p < 0.05$), indicating a significant effect between the use of the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood. Based on the results of the study, it can be concluded that the use of the Smart Fruit Bag teaching aid is effective in improving the understanding of basic mathematics and science concepts in early childhood. This learning medium can help children understand the concepts of numbers, grouping, colors, shapes, sizes, and observation skills through concrete and enjoyable learning activities. Therefore, the Smart Fruit Bag teaching aid can be used as an alternative, innovative learning medium to improve the quality of learning in Early Childhood Education.

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INTRODUCTION

Early Childhood Education (PAUD) is a level of education that plays a crucial role in developing all aspects of a child's development, including cognitive, social-emotional, language, moral, and motor skills. Early childhood is often referred to as the golden age because this period is

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characterized by rapid brain development, and the stimulation provided will influence a child's abilities at subsequent stages. Therefore, learning in early childhood needs to be designed in an engaging, enjoyable manner, and tailored to the child's developmental characteristics to optimally achieve learning objectives.

One aspect of development that needs to be developed early is cognitive abilities, particularly an understanding of basic mathematics and science concepts. Mathematical skills in early childhood include number recognition, number concepts, grouping, sequencing, patterns, measurement, and simple problem-solving. Meanwhile, basic science skills include observing, comparing, grouping, identifying cause-and-effect relationships, and understanding phenomena occurring in the surrounding environment. Mathematics and science instruction provided from an early age will lay the foundation for the development of logical thinking and problem-solving skills at subsequent levels of education (National Council of Teachers of Mathematics, 2022).

According to the National Council of Teachers of Mathematics (NCTM), young children need meaningful mathematics learning experiences through activities that allow them to actively explore, solve problems, communicate ideas, and build conceptual understanding. Learning that emphasizes memorization without concrete experiences is less effective in helping children understand mathematical concepts deeply (National Council of Teachers of Mathematics, 2022).

However, basic mathematics and science learning for early childhood still faces various obstacles. One frequently encountered problem is the use of teacher-centered learning methods and minimal use of concrete learning media. This condition causes children to have difficulty understanding abstract concepts because early childhood thinking is still at the concrete operational stage. As a result, children often have difficulty recognizing number concepts, grouping objects, comparing sizes, and understanding simple phenomena related to science learning.

One effort that can be made to overcome this problem is by utilizing visual aids in the learning process. The use of visual aids allows children to learn through direct experience, making the concepts learned easier to understand. Furthermore, visual aids can also increase children's interest, attention, and engagement during the learning process. Research conducted by Suwardi, Firmiana, and Rohayati shows that the use of teaching aids significantly impacts mathematics learning outcomes in early childhood. Children who learn using teaching aids achieve better learning outcomes than those who learn without them (Suwardi et al., 2014).

The use of teaching aids is not only beneficial in mathematics learning but can also help develop children's basic science skills. Through teaching aids, children can engage in observation, exploration, grouping, and simple experiments, fostering curiosity about their surroundings. Learning that involves hands-on experience has been proven to be more effective in helping children understand science concepts than solely verbal learning.

One learning medium that can be used to develop understanding of basic mathematics and science concepts is the Smart Fruit Bag. This teaching aid consists of bags containing pictures or replicas of various types of fruit that can be used to introduce the concepts of number, counting, grouping, color, shape, size, and characteristics of fruit. Through this medium, children can learn while playing, making the learning process more enjoyable and aligned with the developmental characteristics of early childhood.

Based on initial observations at the AR-Rohman Early Childhood Education Center (PAUD) in Aek Marian Village, Lembah Sorik Marapi District, it was discovered that some children's understanding of basic mathematics and science concepts was still suboptimal. Some children still had difficulty recognizing the number of objects, grouping objects based on certain characteristics, and understanding simple science concepts. Furthermore, the use of innovative and engaging learning media was still limited, resulting in suboptimal child engagement in the learning process.

Although various studies have demonstrated the effectiveness of using teaching aids in improving mathematics learning outcomes, research specifically examining the effect of the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood is still relatively limited. Therefore, this study is important to determine the effect of the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood at the AR-Rohman Early Childhood Education Center (PAUD) in Aek Marian Village, Lembah Sorik Marapi District. The results of this study are expected to serve as a reference

for PAUD teachers in developing innovative, creative, and developmentally appropriate learning media.

IMPLEMENTATION METHOD

This study employed a quantitative approach with a pre-experimental design. The quantitative approach was used because the study aimed to examine the effect of using the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood through numerical data measurement and statistical analysis (Creswell & Creswell, 2023). The research design used was a One-Group Pretest-Posttest Design, a research design involving one group of subjects who were given an initial test (pretest), then given treatment in the form of learning using the Smart Fruit Bag teaching aid, and then given a final test (posttest) to determine changes that occurred after the treatment (Sugiyono, 2020). This design was chosen because it is suitable for determining the effectiveness of a treatment on the same group through a comparison of pre- and post-treatment results (Aditia & Pratiwi, 2024).

The study was conducted at the AR-Rohman Early Childhood Education School (PAUD) in Aek Marian Village, Lembah Sorik Marapi District, Mandailing Natal Regency. The study was conducted on May 9, 2026. The population in this study was all 30 children in Group B at the AR-Rohman Early Childhood Education Center (PAUD AR-Rohman). Given the relatively small population, the sampling technique used was total sampling, meaning all members of the population were used as samples, resulting in a total sample size of 30 children.

The variables in this study consisted of independent and dependent variables. The independent variable (X) was the use of the Smart Fruit Bag teaching aid, a learning medium consisting of pockets containing pictures or replicas of fruit used to help children understand basic mathematics and science concepts through play-while-learning activities. The dependent variable (Y) was the understanding of basic mathematics and science concepts in early childhood, including the ability to recognize numbers, count objects, group objects based on certain characteristics, recognize colors, recognize shapes, compare sizes, and identify simple characteristics of objects.

Data collection techniques used in this study included observation, testing, and documentation. Observations were conducted to observe children's activities during the learning process using the Smart Fruit Bag teaching aid. Tests were used to measure the children's level of understanding of basic mathematics and science concepts before and after the treatment. The assessment instrument was developed based on early childhood cognitive development indicators using a developmental assessment scale consisting of categories: Not Yet Developing (BB), Beginning to Develop (MB), Developing as Expected (BSH), and Very Well Developed (BSB). Documentation was used to supplement the research data, including activity photos, attendance lists, and other supporting documents.

The data obtained were analyzed using the Statistical Package for Social Sciences (SPSS). The analysis began with descriptive analysis to determine the mean, minimum, maximum, and standard deviation of the pretest and posttest results. Normality was then tested using the Shapiro-Wilk Test because the sample size was less than 50 respondents. If the data were normally distributed (significant value > 0.05), the hypothesis was tested using the Paired Sample t-Test. However, if the data were not normally distributed (significant value < 0.05), the Wilcoxon Signed Rank Test was used as an alternative nonparametric test. The hypothesis of this research is that there is an influence of the use of Smart Fruit Bag teaching aids on the understanding of basic mathematics and science concepts in early childhood at PAUD AR-Rohman, Aek Marian Village, Lembah Sorik Marapi District.

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RESULTS AND DISCUSSION

Validity and Reliability Testing

Table 1. Pretest and Posttest Validity Testing

Variabel		r Tabel	Pearson Correlation	Conclusion
X	P1_1	0,361	0,672	Valid
	P1_2	0,361	0,526	Valid
	P1_3	0,361	0,411	Valid
	P1_4	0,361	0,588	Valid
	P1_5	0,361	0,516	Valid
	P1_6	0,361	0,464	Valid
	P1_7	0,361	0,418	Valid
	P1_8	0,361	0,473	Valid
	P1_9	0,361	0,469	Valid
	P1_10	0,361	0,416	Valid
Y	P2_1	0,361	0,621	Valid
	P2_2	0,361	0,524	Valid
	P2_3	0,361	0,623	Valid
	P2_4	0,361	0,472	Valid
	P2_5	0,361	0,658	Valid
	P2_6	0,361	0,701	Valid
	P2_7	0,361	0,484	Valid
	P2_8	0,361	0,587	Valid
	P2_9	0,361	0,551	Valid
	P2_10	0,361	0,657	Valid

Based on the validity test results presented in Table 1, it is known that all pretest (P1_1 to P1_10) and posttest (P2_1 to P2_10) instrument items have Pearson Correlation values (calculated r) greater than the table r value of 0.361 at a 5% significance level, with a total of 30 children as respondents.

In the pretest instrument, Pearson Correlation values ranged from 0.411 to 0.672. The highest correlation value was found in item P1_1 at 0.672, while the lowest correlation value was found in item P1_3 at 0.411. Nevertheless, all correlation values remained greater than the table r (0.361), thus all pretest items are considered valid and suitable for measuring early childhood basic mathematics and science concept understanding.

Meanwhile, in the posttest instrument, Pearson Correlation values ranged from 0.472 to 0.701. The highest correlation value was found in item P2_6 at 0.701, while the lowest correlation value was found in item P2_4 at 0.472. All correlation values in the posttest instrument were also greater than the r table value (0.361), so all posttest items were declared valid and capable of measuring children's understanding of basic mathematics and science concepts after being treated with the Smart Fruit Bag teaching aid.

Overall, the validity test results showed that the 20-item research instrument, consisting of 10 pretest items and 10 posttest items, met the validity criteria, as all calculated r values were greater than the r table (calculated r > 0.361). Thus, the research instrument was declared valid and could be used for data collection in a study on the effect of using the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood at the AR-Rohman PAUD in Aek Marian Village, Lembah Sorik Marapi District.

Table 2. Pretest and Posttest Reliability

Instrumen	Cronbach's Alpha	Criteria	Conclusion
Pretest	0,666	> 0,60	Reliabel
Posttest	0,778	> 0,60	Reliabel

Based on Table 2, the results of the instrument reliability test were conducted using the Cronbach's Alpha method on 10 questions in the pretest and posttest instruments. The analysis showed that the pretest instrument obtained a Cronbach's Alpha value of 0.666, while the posttest instrument obtained a Cronbach's Alpha value of 0.778.

According to Ghozali (2021), a research instrument can be considered reliable if it has a Cronbach's Alpha value greater than 0.60. Based on this criterion, a Cronbach's Alpha value for the pretest instrument of 0.666 indicates that the instrument has a good level of reliability and can be used as a measurement tool in research. Similarly, the posttest instrument obtained a Cronbach's Alpha value of 0.778, indicating a high level of reliability, capable of producing consistent and reliable data (Ghozali, 2021).

When comparing the two instruments, the reliability value for the posttest was higher than that for the pretest. This indicates that the inter-item consistency of the posttest instrument was stronger than that of the pretest instrument. Nevertheless, both instruments met reliability criteria, as the Cronbach's Alpha values obtained exceeded the minimum threshold of 0.60.

Therefore, it can be concluded that all items in the pretest and posttest instruments exhibited a good level of consistency, making them suitable for measuring early childhood understanding of basic mathematics and science concepts in this study on the impact of the use of the Smart Fruit Bag teaching aid at the AR-Rohman Early Childhood Education Center (PAUD) in Aek Marian Village, Lembah Sorik Marapi District.

Table 3. Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Prestest	.114	30	.200	.962	30	.356
Postest	.101	30	.200	.971	30	.589

a. Lilliefors Significance Correction

Based on Table 3, the data normality test was conducted using the Shapiro-Wilk method because the study sample size was less than 50 respondents, namely 30 children. The normality test aims to determine whether the research data is normally distributed before hypothesis testing is conducted.

The results of the normality test indicate that the pretest variable obtained a significance value (Sig.) of 0.356, while the posttest variable obtained a significance value (Sig.) of 0.589. Both significance values are greater than the 0.05 level ($p > 0.05$). Thus, it can be concluded that the pretest and posttest data are normally distributed.

Furthermore, the Shapiro-Wilk statistic value for the pretest was 0.962 and the posttest was 0.971, indicating that the data distribution is quite close to a normal distribution. These results indicate that the research data meets the assumption of normality, allowing further analysis using parametric statistical tests, namely the Paired Sample t-Test, to determine the effect of using the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood.

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Table 4. t-test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	20.380	3.437		5.929	.000
	Prestest	.499	.145	.544	3.429	.002

a. Dependent Variable: Postest

Based on the results of the simple linear regression analysis in the Coefficients table, the constant value was 20.380 and the regression coefficient for the Pretest variable was 0.499. Thus, the resulting regression equation is:

$$Y=20.380+0.499XY = 20.380 + 0.499XY=20.380+0.499X$$

Where:
Y = Posttest
X = Pretest
20.380 = constant
0.499 = regression coefficient

This equation indicates that every one-unit increase in the pretest score will increase the posttest score by 0.499 units. A positive regression coefficient indicates a positive relationship between the pretest and posttest scores.

Based on the results of the partial test (t-test), the calculated t-value was 3.429 with a significance value (Sig.) of 0.002. Because the significance value is less than 0.05 ($0.002 < 0.05$), H_0 is rejected and H_a is accepted. This indicates that the pretest variable has a significant effect on the posttest.

Furthermore, the Standardized Coefficients Beta value of 0.544 indicates a moderate to strong relationship between the pretest and posttest variables. A positive beta value indicates that the higher a child's initial ability, the higher their ability after being taught using the Smart Fruit Bag teaching aid.

DISCUSSION

The results of this study indicate that the use of the Smart Fruit Bag teaching aid has a positive impact on the understanding of basic mathematics and science concepts in early childhood at the AR-Rohman Early Childhood Education Center (PAUD) in Aek Marian Village, Lembah Sorik Marapi District. This improvement is evident in the children's scores after being exposed to the aid. This improvement indicates that the use of concrete learning media can help children grasp previously difficult concepts. This finding aligns with the opinion of Suwardi, Firmiana, and Rohayati (2014), who stated that the use of teaching aids can improve mathematics learning outcomes by helping students understand concepts in a more concrete and meaningful way (Suwardi et al., 2014).

This improvement in understanding of mathematical concepts is evident in the children's ability to recognize numbers, count fruit, group objects by color and type, and compare sizes. Through the use of the Smart Fruit Bag, children can directly engage in counting and grouping activities, making abstract mathematical concepts more concrete. According to the National Council of Teachers of Mathematics (NCTM, 2022), mathematics learning in early childhood needs to be done through direct experiences that allow children to build conceptual understanding based on activities they do themselves.

In addition to improving math skills, using the Smart Fruit Bag can also enhance children's understanding of basic science concepts. During the learning process, children are encouraged to observe the shapes, colors, sizes, and characteristics of various types of fruit displayed in the learning media. This activity fosters observation, classification, and identification skills, which are part of basic science process skills. According to Hasana, Maulana, and Elnawati (2025), science learning that involves hands-on experience and exploratory activities can improve children's ability to understand simple science concepts found in their surroundings (Hasana et al., 2025).

The success of the Smart Fruit Bag teaching aid is also influenced by the media's engaging and child-friendly characteristics. At an early age, children tend to be more interested in learning through play than through lectures. Therefore, learning that integrates elements of play and learning will be more effective in increasing children's motivation to learn. This aligns with the opinion of Clements, Copple, and Hyson (2002), who explained that learning that involves concrete and enjoyable activities can help children develop mathematical thinking skills more optimally (Clements et al., 2002).

During the learning process, children appeared more active and enthusiastic than before the use of teaching aids. They not only listened to the teacher's explanation but also directly participated in counting, grouping, and identifying fruit. This active involvement enables children to have a more meaningful learning experience. According to Aisyah and Purwanti (2023), children's active involvement in the learning process is a crucial factor in improving conceptual understanding and learning outcomes in early childhood (Aisyah & Purwanti, 2023).

Based on the results of a simple linear regression test, a significance value of 0.002 was obtained, which is lower than the 0.05 level ($0.002 < 0.05$). These results indicate that the use of the Smart Fruit Bag teaching aids significantly impacts the understanding of basic mathematics and science concepts in early childhood at the AR-Rohman PAUD in Aek Marian Village, Lembah Sorik Marapi District. Therefore, the alternative hypothesis (H_a) is accepted and the null hypothesis (H_0) is rejected. These findings indicate that the use of concrete learning media can help children understand mathematical and scientific concepts more effectively than learning that only relies on verbal explanations (Rahman & Nurhayati, 2023).

The regression coefficient value of 0.499 indicates that every one-unit increase in a child's initial ability is followed by a 0.499-unit increase in learning outcomes after using the Smart Fruit Bag teaching aid. These results indicate a positive relationship between the use of concrete learning media and improvements in children's cognitive abilities. According to research conducted by Wulandari and Setyaningsih (2024), the use of manipulative media in early childhood learning can improve logical thinking skills and conceptual understanding because children have the opportunity to interact directly with the learning objects.

The significant effect found in this study can be explained by the characteristics of early childhood cognitive development, which is still in the preoperational stage. At this stage, children understand information more easily through concrete objects than symbols or abstract concepts. The Smart Fruit Bag teaching aid allows children to directly count, group, compare, and identify objects, making the concepts learned easier to grasp. Research by Pratiwi and Kurniawati (2024) shows that the use of concrete media in early childhood mathematics learning can significantly improve basic numeracy skills because children learn through real-life experiences (Pratiwi & Kurniawati, 2024).

The improvement in children's post-test results also indicates that the use of the Smart Fruit Bag can improve their understanding of basic mathematical concepts such as recognizing numbers, counting objects, grouping objects by color and type, and comparing sizes. These activities provide meaningful learning experiences because children not only listen to the teacher's explanation but also participate directly in the learning process. Research by Putri, Yuniarti, and Sari (2024) indicates that educational game-based learning can improve numeracy skills and mastery of early childhood mathematical concepts more effectively than conventional learning methods (Putri et al., 2023).

In addition to mathematics, the use of the Smart Fruit Bag also influences children's understanding of basic science concepts. During learning activities, children are encouraged to observe the characteristics of fruit, distinguish colors, sizes, and shapes, and group objects based on certain characteristics. These activities are part of science process skills, which are crucial to develop

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from an early age. According to research by Hidayat and Pramono (2024), science learning based on exploration and direct observation can improve scientific thinking skills, curiosity, and observation skills in young children (Hidayat & Pramono, 2024).

The Standardized Coefficients Beta value of 0.544 indicates a moderate to strong relationship between the pretest and posttest variables. This indicates that the use of the Smart Fruit Bag teaching aids significantly contributed to improving children's abilities. However, improvements in children's learning outcomes are influenced not only by the learning media but also by other factors such as teacher teaching methods, the learning environment, children's learning motivation, and family support. Similar findings were reported by Arianti (2017), who stated that the success of early childhood learning is influenced by a combination of learning media, teacher strategies, and a conducive learning environment (Arianti, 2017).

The successful use of the Smart Fruit Bag also demonstrates that learning media that are close to children's daily lives are easier to understand than abstract media. Fruit is an object children frequently encounter in everyday life, making it easier for them to connect learning experiences with real-life experiences. This kind of contextual learning has been shown to improve children's retention and conceptual understanding. This aligns with research by Novitasari and Fauziddin (2022), which found that the use of contextual, environment-based media can improve learning outcomes and children's engagement in the learning process (Novitasari & Fauziddin, 2022).

Overall, the results of this study demonstrate that the use of the Smart Fruit Bag teaching aid significantly impacts early childhood children's understanding of basic mathematics and science concepts. A significance value of 0.002 indicates that this media is effective as a learning tool for enhancing children's cognitive abilities. Therefore, early childhood education teachers are advised to utilize more concrete and innovative learning media that enable children to learn through direct experience. This way, the learning process becomes more engaging, meaningful, and can optimally improve the quality of children's learning outcomes (Lestari & Fitriani, 2024).

CONCLUSION

Based on the results of the study on the effect of using the Smart Fruit Bag teaching aid on the understanding of basic mathematics and science concepts in early childhood at the AR-Rohman Early Childhood Education Center (PAUD) in Aek Marian Village, Lembah Sorik Marapi District, it can be concluded that the use of the Smart Fruit Bag teaching aid significantly improved children's understanding of basic mathematics and science concepts. This is demonstrated by the validity test results, which stated that all research instrument items were valid, with a Pearson Correlation value greater than the table r value (0.361). The reliability test results showed a Cronbach's Alpha value of 0.666 for the pretest instrument and 0.778 for the posttest instrument, thus declaring the research instrument reliable and suitable for use.

The results of the normality test using the Shapiro-Wilk method indicated that the pretest and posttest data were normally distributed, with significance values of 0.356 and 0.589, respectively ($p > 0.05$). Furthermore, the results of the simple linear regression test showed a significance value of 0.002 ($p < 0.05$), thus the alternative hypothesis (H_a) was accepted and the null hypothesis (H_0) was rejected. Therefore, it can be concluded that the use of the Smart Fruit Bag teaching aid significantly influences the understanding of basic mathematics and science concepts in early childhood.

The use of the Smart Fruit Bag teaching aid has been proven to help children understand number concepts, count objects, group objects based on certain characteristics, recognize colors, shapes, and sizes, and develop observation skills as part of basic science learning. Furthermore, this medium can also increase children's engagement and enthusiasm during the learning process because it provides a concrete, engaging learning experience that aligns with the developmental characteristics of early childhood. Therefore, the Smart Fruit Bag teaching aid can be used as an effective alternative learning medium to improve children's cognitive abilities, particularly in understanding basic mathematics and science concepts in early childhood education institutions.

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