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The Influence of Wood Energy Kit Educational Play Tools on Early Childhood Science Literacy Skills

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A B S T R A C T

This study investigated the effect of the Wood Energy Kit educational game on early childhood science literacy. A pre-experimental one-group pretest-posttest design was employed, involving the entire population as the sample. Observations at KB Dahlia Sukomaju had previously indicated low science literacy due to a lack of interactive, con-crete, and hands-on media. The results showed a significant improvement in children's science literacy scores (mean pretest = 20.23, mean posttest = 32.62), a paired-sample t-test confirmed the significance (2-tailed = 0.000 < 0.05), leading to rejection of the null hypothesis. These findings suggest that concrete, experience-based learning media effectively enhance young children's understanding of basic science concepts, particularly regarding energy.

INTRODUCTION

Early childhood science education is a crucial focus in developing the quality of human resources for the 21st century. Many countries prioritize scientific thinking, creativity, problem-solving, and scientific literacy as core competencies that should be introduced from early childhood. Quoted from research (Zuhdi & Djufri, 2026) UNESCO organization confirms that science experiences at an early age influence cognitive development, critical thinking skills, and children's readiness to learn at the next level. Global phenomena show that early childhood science learning still faces various challenges, especially the low use of exploratory media and the lack of direct experiment-based learning experiences.

Early childhood according to (Nabila & Sit, 2024) is an individual who is in the phase of the growing process that takes place very quickly, includes both physical and psychological aspects, even often referred to as the acceleration phase of development. At this stage, children begin to understand their increasingly diverse surroundings through play and exploration. Early childhood is entering a period of immense value compared to subsequent stages of development; this stage is often called the "golden age." (*the golden age*) as it is undergoing a significant development of intelligence and becomes the basis for the formation of human qualities in the future (Yusuf et al., 2023).

Early childhood foundational education is a crucial foundation for developing children's basic competencies. One example is literacy development. The concept of child literacy is a continuous and highly dynamic process, encompassing the development of a desire to ask questions, critical reasoning skills, oral language skills, and ultimately, literacy skills in reading and writing. (Salsa et al., 2024). Based on the National Education System legislation (Law No. 20 of 2003). Early Childhood Education (PAUD) is defined as the process of nurturing children from birth to age six. This process involves providing various educational stimuli to support their physical and mental growth until they are ready to advance to the next level of education. (Yusuf et al., 2023).

Understanding science is not just about understanding scientific concepts, but also includes the skills to think deeply and rationally, observe, make predictions, and carry out simple experiments that can be done in daily activities. (Nurhaswinda. & Parisu, 2025). Science literacy instilled from an early age can provide children with provisions to become individuals who are able to adapt to the advances in science and technology that will come (Berkarya et al., 2025). According to (Sholeha et al., 2022) the results of an international survey conducted by the OECD to measure the basic literacy achievements of 15-year-old students such as reading, mathematics, and science called PISA. PISA conducted in 2018 with Indonesian respondents amounting to 3.7 million learners and the results obtained is Indonesia occupies the bottom 10 position of 79 participating countries and the average literacy ability of Indonesian students is 80 points below the OECD average so that literacy understanding needs to be improved since early childhood (Literasi & Indonesia, 2021).

Science literacy is the ability of individuals to apply scientific foundations to recognize problems, formulate questions, and draw conclusions based on empirical evidence, so that individuals are able to understand and make decisions related to events that occur in the environment (Noor, n.d.). Scientific literacy not only hones children's critical thinking and creativity skills but also instills a sense of responsibility toward the environment and society. Children who understand scientific literacy are more likely to make informed decisions and utilize science and technology to solve problems. Thus, scientific literacy plays a vital role in improving the well-being of humanity in the future. (Anggreni et al., 2022).

Basic science skills in early childhood in Indonesia are starting to receive attention, but in their implementation they still face several challenges. Research conducted by (Yawan et al., 2025) Studies have shown that simple experimental activities can improve basic science skills in 5–6 year old children in terms of logical thinking, following directions, and observing natural processes. However, because most research still uses conventional media or general experiments, The use of specialized media such as wood energy kits has not been thoroughly studied. This wood energy kit is made of wooden wheels equipped with a dynamo and a small light. When the wheels on this educational wood energy kit are turned, they produce light. This type of educational game tool is very easy to find in online stores such as Shopee and Tokopedia with the product category with the best sales performance, educational game tools (APE) have been shown to improve children's cognitive aspects, language, and scientific literacy. Research by Fitriyani et al. (2020) At PP IPTEK TMII Jakarta, it was demonstrated that using APE (Age of Educational Games) can be used to teach more than just play, transforming them into meaningful learning tools. Therefore, new innovations in the use of play equipment, such as wood energy kits, can help students learn about scientific literacy.

However, researchers can identify research differences. There are several differences in APE research. First, most studies focus on traditional media, not media specifically addressing energy concepts. Second, the scientific literacy aspects evaluated focus solely on observation, while scientific thinking skills such as experimentation and conclusion-drawing are rarely examined. (Anggreni et al., 2022). Third, research is often only conducted in large cities where the resources are quite complete, so that research in local contexts such as PAUD with limited facilities is still less researched. (Sulistyowati et al., 2025). Based on these conditions, this study has novelties. Among them are: First, it presents a new learning medium in the form of a wood energy kit that integrates the concept of energy with natural wood-based materials, making it environmentally friendly and appropriate to children's environment and real world. Second, this study assesses scientific literacy more comprehensively, starting from conceptual understanding and scientific process skills to fostering children's scientific attitudes. Third, this study provides a contribution that can be easily implemented by early childhood education teachers in their efforts to develop fresher and more varied teaching media in line with the demands of 21st-century learning.(Anggreni et al., 2022).

Based on these conditions, this study presents several novelties: it presents a new learning medium in the form of a wood energy kit that integrates energy concepts with natural wood-ba-sed materials, making it environmentally friendly and appropriate for children's environments and the real world. Therefore, research that can provide empirical evidence regarding the effecti-veness of wood energy kits in developing early childhood scientific literacy is needed.

METHOD

The research entitled "The Effect of the Wood Energy Kit Educational Game Tool on the Science Literacy Skills of Early Childhood Education" uses a quantitative approach. With the type of pre-experiment, the pre-experimental design used is One Group Pretest-Posttest Design, namely a research design that involves one group of subjects who are given an intervention, and measurements are taken before and after the intervention to observe significant changes. (. et al., 2018). This research took place from October to December at the Dahlia Sukomaju Playgroup. The Dahlia Sukomaju Playgroup is an institution that not only serves children of playgroup age but also accepts children of kindergarten age.

This policy was taken as a response to the geographical conditions and needs of the surrounding community. In fact, the location of the institution is relatively far from other kindergarten institutions, so it is one of the main considerations. This limited access has the potential to hinder kindergarten-aged children from obtaining optimal educational services. In addition to the community's needs, this policy also does not conflict with the regulations in force in the PAUD implementation system in accordance with PERMEN 137 article 36 which states that Playgroups are one form of early childhood education through Non-Formal Education that provides educational services for children aged 2 (two) to 6 (six) years which functions to assist the growth and development of children so that they are ready to enter further education. (Pendidikan et al., 2014; Qori'ah, 2026). Thus the reception of kindergarten-aged children in Dahlia's family planning is understood as a form of institutional adaptation to societal needs.

Based on these conditions, the researcher set the focus of the study in group B with the age range of 5-6 years in KB Dahlia. The choice of this group is based on the reason that the child at the vulnerable age of 5-6 middle years experiences a stage of development that is more ready to be introduced to concepts – simple concepts in science literacy, such as observing, asking, trying, and communicating the results of observations (Westhisi et al., n.d.). As for the population in the study involved a total of 26 children, who were all group B learners in KB Dahlia. The sampling technique used was saturation sampling, so that the entire population was used as the study sample. The choice of this technique was made due to the relatively limited number of subjects, thus allowing the researcher to involve the entire learner in order to obtain more comprehensive and representative data (Fadillah & Oktoviani, 2026).

The method of data collection in this study was implemented by means of observation, documentation in the form of photographs and videos, as well as recording the results of learning activities. Observation is used to directly observe the development of children's science literacy skills as the learning process unfolds (Maya Laela Sari TK YPWK, 2021). Meanwhile, photo and video documentation were used as supporting data that reinforced the observation results as well as providing a real picture regarding the child's activities in the learning activities. Thus, through the collection technique of such data, the researcher is expected to obtain accurate and in-depth data related to children's science literacy skills in vulnerable 5–6-year-olds in KB Dahlia. The instrument in this study was developed based on the indicators of child science literacy skills in vulnerable 5-6 years old which includes the ability to pay close attention, question, try, and put forward the results of observations. The development of the instrument began with the compilation of a grid adapted to the objectives of the study, followed by the creation of an observation sheet as a tool to measure children's science concept understanding skills.

Table 1. Science Literacy Indicators

Aspects of SCIENCE literacy aud	Description	indicator
Curiosity (*Scientific Curiosity)*	The natural urge to explore the environment needs to be stimulated through observation, asking questions, and simple experimentation.	The child is able to name objects that can emit light
		Children are able to name when the moon shines
		The child shows a curious expression when the light comes on
Understanding Science Concepts	The process of building knowledge through active exploration of the universe and the phenomena around	The child knows that the light is on because there is power/energy from the appliance

	it. Its main focus is that the child can understand themselves, the natural environment, as well as phenomena that arise in everyday life.	The child is able to demonstrate objects that can provide light and warmth (fire, Candles)
		The child is able to tell the phenomenon that often appears after the rain (rainbow)
Science Process Skills	Basic abilities that children use to investigate, understand nature, and build knowledge through direct experience.	The child is able to name and use objects that can help illuminate in the dark (flashlights, lamps)
		Child is able to name objects that shine at night other than the moon (stars)
		Child is able to show the part that can light up on the car (car headlights)

Source modified from :(Anggreni et al., 2022)

The instruments used were in the form of observation sheets with measurement scales referring to the holistic development of the toddler such as, Not Developing (BB), Beginning to Develop (MB), Developing as Expected (BSH), Excellent Developing (ESD). Furthermore the instrument will be tested for feasibility through validity testing to ensure the appropriateness of the content of the instrument with the indicators being measured. Based on the results of the reliability test obtained a Cronbach's Alpha value of 0.0782 with the number of items 10. The value is greater than 0.7, so it can be concluded that the research instrument has a good reliability and is worthy of use in the research. after treatment. Thus, the instruments used were able to accurately and consistently measure children's science literacy skills.

The data analysis techniques applied to this study are descriptive and inferential quantitative analysis. The data obtained from the pretest and posttest results were analyzed to find out the presence of improvement in children's science literacy skills. Descriptive statistical analyzes were used to describe mean scores, percentages, as well as categories of development of children's ability to understand science concepts before and after the administration of educational play tools. Meanwhile, inferential analysis was conducted by using a statistical test i.e. Paired sample t-test, to find out whether there is a significant difference between the pretest and posttest results (Huda, n.d.).

Before hypothesis testing is implemented, first a prerequisite test in the form of a normality test is conducted to ensure that the data are normally distributed or not. If the data meets the assumption of normality, then the paired sample t-test can be used to test the hypotheses of the study (Prasetyo & Sabilah, 2024). Thus, the executed analytical technique is expected to display an accurate portrait regarding the improvement of children's science literacy skills in susceptible 5–6-year-olds in KB Dahlia after treatment administration.

RESULT AND DISCUSSION

Based on the results of the research that has been conducted, data were obtained regarding the comparison of children's scientific thinking skills between the initial and final conditions af-ter the treatment as follows:

Figure.1. Documentation *Pretest dan Posttest*

The pretest and posttest results were intervened through the result scores recapitulating the pretest and posttest data. To further refine the presentation of the quantitative data, the measure-ment results of children's science literacy skills before and after the wood energy kit educational play tool intervention were not only exposed with tables but also visualized in bar diagrams. This visualization aims to provide a clearer and more comprehensive picture of the differences betwe-en pretest and posttest scores for each subject. The diagram depicts trends in individual and col-lective score improvement as well as facilitates identification of patterns of change following the intervention. Therefore the graphical representation is expected to aid the visual interpretation of the data and strengthen the finding that the wood energy kit educational play tool has a positive impact on early childhood science literacy skills.

Ofcourse before the posttest the researcher has given treatments using the media Wood En-ergy Kit educational toys to children as follows:

Figure.2. Documentation *Pretest dan Posttest*

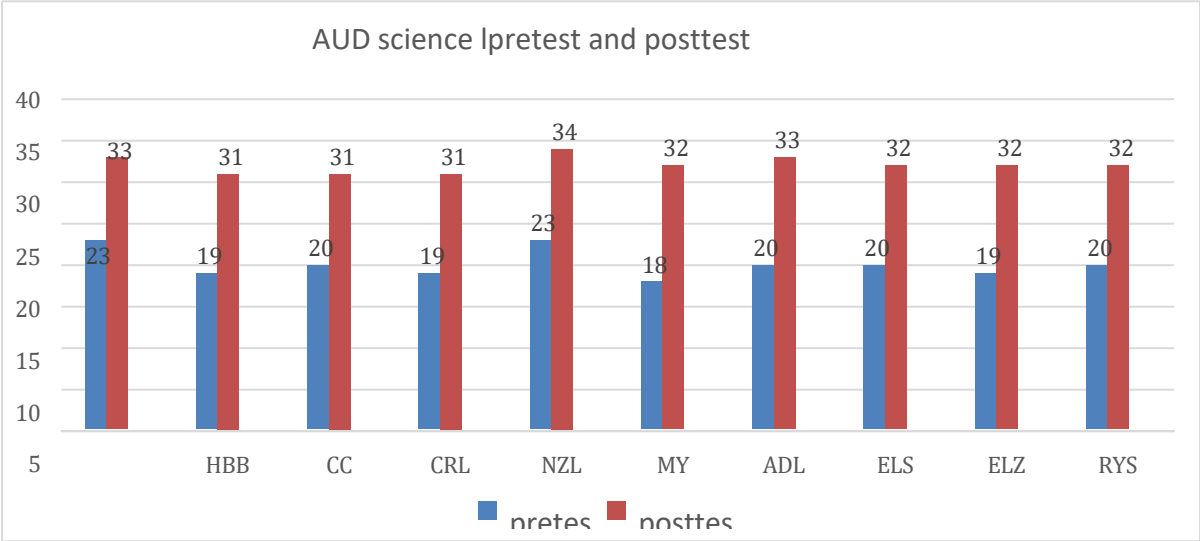

Figure.3. Recaptulation of Pretest and Postest Score Data

Based on the results presented in the score comparison table, it can be seen that all study participants experienced an increase in their science literacy skills scores after participating in the learning session using the wood energy kit educational game tool. Participants' pretest sco-res ranged from 19 to 23, increasing to 31 to 34 at posttest. The mean pretest score of 21.67 in-creased to 32.67 in the posttest, with a mean improvement of 11 points. In detail, DVN experi-enced an increase from 23 to 33 (an increase of 10 points), and NZL improved from 23 to 34 (an increase of 11 points). This increase occurred consistently in all subjects, with no decline or stagnation in scores. This suggests bringing interventions in the form of wood energy kits contri-butes positively to the development of early childhood science literacy.

Based on the data recapitulation results, there was an increase in jumping ability from the pretest to the posttest. This recapitulation was followed by statistical testing to produce reliable results.

Table. 3. Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PRETEST	.249	26	.000	.881	26	.006
POST-TEST	.178	26	.033	.936	26	.106

a. Lilliefors Significance Correction

Table 3 shows that the results of the normality test for pretest and posttest scores were not entirely normally distributed. This is indicated by a pretest significance level of 0.006 and a posttest significance level of 0.016. The pretest significance level was less than 0.05, while the posttest significance level was greater than 0.05. Based on the decision-making process, if the probability value (Sig.) is greater than 0.05, the data are normally distributed. Therefore, it can be concluded that the posttest data are normally distributed, while the pretest data are not.

Table. 4. Statistical Test Results

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 PRETEST	20.23	26	1.608	.315
POST_TEST	32.62	26	1.329	.261

Table. 5. Paired Sample Test

Paired Sample Test								
Pair 1 Pretest-postest	Mean	Std Deviation	Std.Error Mean	Lower	Upper	t	df	Sig. (2)
	-12.385	1.416	.278	-12.957	-11.813	-44.585	df	.00

The results show a significance value of 0.000, thus in accordance with the basis for deci-sion making, namely if the significance value (Sig. 2-tailed) is 0.000 < 0.05, then Ha is accepted and H0 is rejected. This means that there is a significant influence of the use of wood energy kit media on early childhood science literacy skills.

During the posttest, the scientific literacy skills of early childhood children in group B sig-nificantly improved after the implementation of the Wood Energy Kit educational play tool com-pared to before the implementation. Children began to demonstrate better observation skills, where they were able to observe various simple phenomena related to energy through contextual play activities. In the skill of collecting data and information, children began to become accusto-med to recognizing objects that can produce energy and understand the function of each component in the Wood Energy Kit media. Furthermore, children's ability to process information also experienced rapid progress, demonstrated by their ability to re-explain the results of their obser-vations in simple terms.

Based on the results of this study, in line with several studies conducted by Anggraeni, which on the understanding of scientific literacy, showed that the use of educational play tools Wood Energy Kit has an influence on the understanding of scientific literacy of early childhood, especially at the age of 5-6 years. This understanding of scientific literacy is in line with the in-dependent curriculum, which is one of the learning outcomes that must be achieved by early childhood, this is integrated through robotics-based technology which concretely presents ob-jects.

Apart from that, theoretically, the use of concrete media in early childhood learning is in line with Jean Piaget's cognitive development theory. (Piaget, 1952) which states that children aged 5-6 years are in the pre-operational stage, where children learn more effectively through di-rect experience and real objects. (Aisyah, 2013). The wood energy kit provides children with the opportunity to explore, observe, and directly experience how energy works through play. This process helps children build three levels of knowledge: assimilation by integrating new informa-tion into their cognitive structure. Children begin to recognize that the tool relates to the concept of energy they have previously encountered in everyday life. Accommodation is the process by which children change or adjust their thinking structure due to new experiences that are inconsis-tent with previous experiences. This allows them to think about the cause and effect of how to produce light energy from the wood energy kit, which must be rotated first to produce light. Equ-ilibration is the process of balancing assimilation and accommodation, resulting in a more comp-lete understanding. Through this tool,

children develop a more mature concept of energy through the process of rotating the simple wood energy kit.

The learning media used in this study, the APE wood energy kit, is an educational, attrac-tive, and innovative play media. In fact, this media has a high level of interest among users, this can be seen from the large number of enthusiasts and the high number of product sales on online buying and selling platforms. This shows that the APE wood energy kit is not only visually at-tractive, but also considered effective and useful in supporting children's learning processes. In-terest in this media was also seen during the learning process, where children showed great en-thusiasm, actively involved in activities, and more easily understood the concepts presented. Thus, the use of the APE wood energy kit is not only theoretically relevant, but also supported by empirical facts in the field that this media is in demand and widely used as a fun learning medium.

CONCLUSION

This study proves that the use of wood energy kit media is effective in improving early childhood science literacy skills. This is indicated by the presence of a 2-tailed effect of 0.000 <0.05, so the alternative hypothesis (Ha) is accepted and the null hypothesis (H0) is rejected. This study still has limitations, namely the study was only conducted on one group without a control class so that the effect of the media has not been compared with other learning media. The research subjects were also limited to one institution with a relatively small sample size, so the results of the study cannot be generalized widely. In addition, the study focused on children's science literacy skills in a relatively short treatment period so that it has not measured the long-term impact of media use. In line with the research results, it is recommended for early childhood educators to use media as an alternative to more innovative and enjoyable science learning. For future researchers, it is recommended to conduct research involving a control group, a larger sample size, and develop media variations or test its effect on other aspects of child develop-ment.

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