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The Use of Recycled Material-Based Educational Play Tools (APE) to Improve Fine Motor Skills

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ABSTRACT
This study aims to analyze the effectiveness of using recycled-material Educational Play Tools (APE) in improving early childhood fine motor skills. The background of this study is the low ability of children in activities such as cutting, pasting, and threading, as well as the suboptimal use of creative learning media. The study employed a quantitative approach with a quasi-experimental design using a One Group Pretest-Posttest model involving 12 children aged 3–4 years. Data were collected through observation, performance assessment, and documentation, and then analyzed using descriptive quantitative techniques. The results showed a significant improvement, indicated by an increase in percentage from 25% to 83.3%. Improvements were observed in cutting, pasting, threading, and hand-eye coordination skills. These findings indicate that recycled-material APE is effective, innovative, and environmentally friendly, and can serve as an alternative learning medium to optimally support children's fine motor development.

Keywords: Educational Play Tools (APE), Recycled Materials, Fine Motor Skills, Early Childhood.

I. Introduction

Early Childhood Education (ECE) is an important foundation in shaping the quality of human resources, as this stage represents the golden age, a period of rapid development in cognitive, language, social-emotional, and physical-motor aspects (Santrock, 2018). Appropriate and continuous stimulation during this period is essential to optimize all aspects of a child's developmental potential. One of the developmental domains that plays a crucial role in preparing children for the next level of education is fine motor skills. Fine motor skills involve the coordination of small muscles, particularly in the hands and fingers, which are required in various activities such as writing, drawing, cutting, pasting, and stringing beads (Papalia & Martorell, 2021). Optimal development of fine motor skills not only supports academic readiness but also enhances children's independence and self-confidence in performing daily activities.

However, various field findings indicate that the fine motor skills of early childhood learners are still not optimally developed. This is characterized by children's low ability to perform activities requiring hand-eye coordination, such as cutting along patterns, pasting neatly, and arranging objects in an organized manner. This condition indicates a gap between expected developmental outcomes and the reality of classroom learning (Suyadi, 2017). One of the factors contributing to this issue is the suboptimal use of learning media that can actively stimulate children's motor activities. In ECE practices, many educators still rely on conventional approaches with limited and less varied media, resulting in children not receiving

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exploratory and meaningful learning experiences. In fact, learning in early childhood should be designed through a play-based approach (learning by doing) that involves direct interaction with objects (Morrison, 2018).

In this context, the use of Educational Play Tools (Alat Permainan Edukatif/APE) is considered an effective alternative solution. APE are learning media designed to stimulate various aspects of child development through educational play activities. The use of APE allows children to engage in manipulative activities that directly train hand-eye coordination (Suryani & Agung, 2018). Along with the growing issue of environmental sustainability, the utilization of recycled materials as learning media has become increasingly relevant. Materials such as used cardboard, plastic bottles, and paper waste can be creatively and innovatively used as APE cost-effectively. In addition to stimulating fine motor development, the use of recycled materials can also instill environmental awareness and creativity in children from an early age (Widodo, 2019).

Several previous studies have shown that the use of manipulative activity-based learning media has a positive effect on improving children's fine motor skills (Papalia & Martorell, 2021; Morrison, 2018). Furthermore, the use of APE has also been proven to enhance learning motivation and active participation among children (Suryani & Agung, 2018). However, most of these studies still focus on learning media in general without integrating environmental sustainability aspects. Thus, there is a research gap, namely the limited number of studies that specifically examine the effectiveness of APE made from recycled materials in improving early childhood fine motor skills measurably. In addition, existing studies tend to use qualitative or classroom action research approaches, with few employing a quantitative experimental design.

Based on this, the novelty of this study lies in the use of recycled-material-based APE, which not only focuses on creativity and sustainability aspects but is also tested for its effectiveness quantitatively through a quasi-experimental approach. This approach provides stronger empirical evidence in measuring improvements in children's fine motor skills. Therefore, this study aims to analyze the effectiveness of Educational Play Tools (APE) made from recycled materials in improving early childhood fine motor skills. The results of this study are expected to contribute theoretically to the development of ECE studies and practically to educators in designing innovative, contextual, and sustainable learning.

II. Literature Review and Hypothesis Development

Early Childhood Education (ECE) is widely recognized as a critical stage in human development, particularly because children experience rapid growth across multiple domains during the early years. According to Santrock (2018), this period, often referred to as the golden age, is characterized by significant development in cognitive, language, social-emotional, and physical-motor abilities. At this stage, learning experiences that are rich, meaningful, and developmentally appropriate are essential in supporting children's overall growth. One of the key developmental domains in early childhood is fine motor skills. Fine motor development refers to the ability to coordinate small muscles, especially in the hands and fingers, which are essential for performing precise tasks such as writing, drawing, cutting, and manipulating small objects (Papalia & Martorell, 2021). The development of fine motor skills is closely related to children's readiness for formal schooling, as it supports early literacy and academic tasks that require hand-eye coordination and control. Morrison (2018) emphasizes that fine motor skills are not only important for academic success but also for fostering independence and self-care abilities in daily life.

The development of fine motor skills is influenced by various factors, including stimulation, learning environment, and learning media used in early childhood classrooms. In many ECE settings, learning is still dominated by conventional instructional methods that provide limited opportunities for children to actively engage in hands-on experiences. Suyadi (2017) argues that insufficient stimulation and lack of appropriate learning media may hinder the optimal development of children's motor abilities, particularly fine motor coordination. To address this issue, the use of Educational Play Tools (Alat Permainan Edukatif/APE) has been widely recommended in early childhood education. APE are defined as instructional media designed to facilitate learning through play, enabling children to explore, manipulate, and interact with objects in

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meaningful ways (Suryani & Agung, 2018). Through play-based learning activities, children are able to develop fine motor coordination naturally while engaging in enjoyable and developmentally appropriate tasks. This aligns with the principle of learning by doing, which is a fundamental approach in ECE (Morrison, 2018).

In addition to supporting developmental outcomes, the integration of recycled materials into APE has gained increasing attention in recent years. Recycled materials such as cardboard, plastic bottles, paper, and other household waste can be transformed into creative and functional learning tools. Widodo (2019) highlights that the use of recycled materials not only provides cost-effective learning media but also introduces environmental awareness and sustainability values to young children. This approach encourages creativity, problem-solving, and ecological responsibility from an early age. Previous studies have shown that manipulative play-based learning media significantly contribute to the improvement of fine motor skills in early childhood (Papalia & Martorell, 2021; Morrison, 2018). Furthermore, APE has been found to increase children's engagement, motivation, and active participation in learning activities (Suryani & Agung, 2018). However, most existing studies tend to focus on general instructional media without specifically integrating sustainability-based materials such as recycled resources. Therefore, there is a need for further research that specifically examines the effectiveness of recycled-material-based APE in improving fine motor skills through a more rigorous methodological approach. This study builds upon previous literature by focusing on the integration of environmental sustainability and motor skill development, while also addressing the gap in experimental quantitative research within the context of early childhood education.

III. Research Method

This study employed a quantitative approach using a quasi-experimental research design. The research design used was a One Group Pretest–Posttest Design, which aims to determine the effect of using recycled Educational Game Tools (EGT) on improving fine motor skills in early childhood by comparing results before and after treatment (Sugiyono, 2019).

The schematic design of this study is as follows:

$$\mathbf{O_1 - X - O_2}$$

Description:

O_1 = pretest (measurement of children's initial fine motor skills)

X = treatment (learning activities using recycled EGT)

O_2 = posttest (measurement of children's final fine motor skills)

This study was conducted at KB Nur Hidayah, Bangunsari Village. The research subjects were a group of 12 preschool children, consisting of boys and girls aged 3–4 years. The sampling technique used was purposive sampling, based on the consideration that the selected children still needed development in fine motor skills, particularly in activities such as cutting, pasting, and beading (Arikunto, 2018).

This research involved two variables: the use of recycled EGT as the independent variable and children's fine motor skills as the dependent variable. The procedure was carried out in three stages: a pretest to measure initial ability, a treatment phase involving manipulative activities using recycled materials, and a posttest to assess improvement. The activities included cutting, pasting, beading, and arranging shapes using a learning-by-doing approach. Data collection techniques included structured observation, performance assessment, and documentation. Observation was used to monitor children's development, performance assessment measured skills directly, while documentation supported the data through photographs of activities and children's work. The research instrument used was an observation sheet of fine motor skills, developed based on early childhood development indicators. The instrument used a developmental rating scale consisting of four categories: Not Yet Developed (NYD), Beginning to Develop (BD), Developing as Expected (DAE), and Very Well Developed (VWD). The assessed indicators included accuracy in cutting along patterns, neatness in pasting, ability to bead or arrange objects, and hand eye coordination.

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The collected data were analyzed using descriptive quantitative techniques, including calculating pretest and posttest scores, converting scores into percentages, comparing pretest and posttest results to determine improvement in fine motor skills, and calculating the N-Gain score to determine the level of effectiveness of the treatment. The results of the analysis were presented in tables and descriptive narratives to clearly illustrate the observed changes. The study was considered successful if it met several criteria: an improvement in children's fine motor skills between pretest and posttest results, at least 75% of children achieving the categories of Developing as Expected (DAE) or Very Well Developed (VWD), and an N-Gain score in the medium or high category.

IV. Result and Discussion

4.1. Analysis Result

This study aims to analyze the effectiveness of using recycled material-based Educational Play Tools (APE) in improving the fine motor skills of early childhood children. Data were obtained from the results of pretest and post test assessments involving 12 preschool children.

a. Pretest and Posttest Results

The initial measurement (pretest) showed that the children's fine motor skills were still relatively low. This is indicated by the low percentage of children who achieved the Expected Development (BSH) and Very Well Developed (BSB) categories, which was only 25%. After the intervention using recycled material-based APE, there was a significant improvement in the children's fine motor skills. The percentage of children achieving the BSH and BSB categories increased to 83.3% in the posttest.

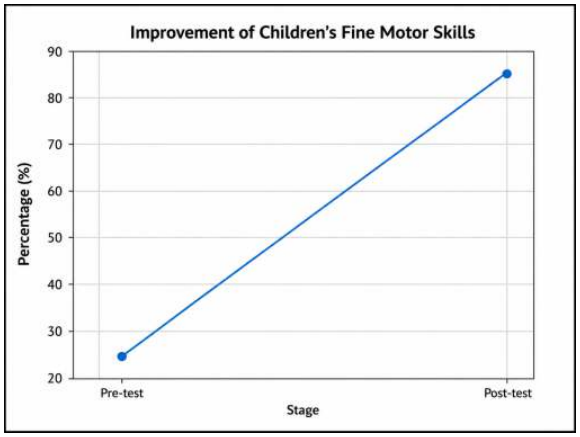

Figure 1. Improvement in Children's Fine Motor Skills

The graph shows a significant upward trend from the initial condition to the final condition after the intervention was implemented. The improvement is presented in the following table:

Table 1. Improvement in Children's Fine Motor Skills

Stage	Percentage of BSH + BSB (%)
Pretest	25.0
Posttest	83.3

Based on Table 1, there was an increase of 58.3% after the intervention. This indicates that the use of recycled material-based APE had a positive effect on children's fine motor development. To further illustrate the comparison between pretest and posttest results, the following figure is provided:

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b. N-Gain Analysis

To determine the level of effectiveness of the intervention, an N-Gain analysis was conducted. Based on the pretest score (25%) and posttest score (83.3%), the N-Gain value obtained was 0.78, which is classified as high. This indicates that the use of recycled material-based APE is effective in improving early childhood fine motor skills.

Table 2. N-Gain Analysis Results

Component	Value (%)	Description
Pretest	25.0	Initial ability
Posttest	83.3	Post-intervention ability
N-Gain	0.78	High category

Based on the analysis, the pretest score of 25% indicates that the children's fine motor skills were still low before the intervention. After the implementation of recycled material-based APE, the posttest score increased to 83.3%, showing a significant improvement. The N-Gain value of 0.78 falls within the high category, indicating that the intervention was highly effective. Therefore, it can be concluded that the use of recycled material-based Educational Play Tools (APE) has a strong positive impact on improving early childhood fine motor skills. This demonstrates that learning methods involving hands-on activities using simple materials can effectively stimulate the development of children's fine motor abilities.

4.2. Discussion

The results of this study indicate that the use of recycled-material Educational Play Tools (APE) significantly improves early childhood fine motor skills. This improvement is demonstrated by an increase in the developmental achievement percentage from 25% in the pretest stage to 83.3% in the posttest stage. In addition, an N-Gain value of 0.78, classified as high, further confirms that the intervention applied is highly effective. These findings suggest that well-designed learning interventions, particularly those involving contextual media and manipulative activities, can have a substantial impact on children's fine motor development. Fine motor skills are a crucial aspect of early childhood development as they are closely related to children's readiness to perform various academic and daily life activities. These skills involve the coordination of small muscles, particularly in the hands and fingers, with visual systems. They are required in activities such as writing, drawing, cutting, and arranging objects. Therefore, appropriate and continuous stimulation is essential to optimize children's fine motor development. This study shows that stimulation through recycled-material APE effectively addresses this need.

The improvement observed in this study is closely related to the manipulative nature of the learning activities. Activities such as threading, pasting, and constructing shapes directly involve hand-eye coordination and intensive use of small muscles. These activities provide children with repeated practice opportunities, leading to strengthened fine motor skills. Cameron et al. (2016) found that manipulative activities are significantly associated with improvements in fine motor skills and early academic readiness, indicating that hands-on learning is more effective than passive learning approaches. Furthermore, the learning-by-doing approach applied in this study plays an important role in enhancing learning effectiveness. This approach positions children as active participants in the learning process, allowing them to gain meaningful direct experiences. Through these experiences, children not only understand concepts cognitively but also internalize skills through practice. Bonawitz et al. (2019) emphasized that active exploratory learning significantly enhances both conceptual understanding and motor skill development in children, making this approach highly relevant in early childhood education.

From a learning media perspective, the use of recycled-material APE offers distinct advantages. It is not only cost-effective but also contextual and easily accessible from the children's surrounding environment. The use of materials such as used straws, recycled paper, and cardboard makes learning more relevant to

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children's everyday lives. This increases children's interest and engagement in learning activities. Fleer (2020) reported that contextual learning media significantly enhance children's engagement in educational activities, which in turn contributes to improved learning outcomes. In addition to improving fine motor skills, the use of recycled materials also provides additional educational value by fostering environmental awareness from an early age. Children are taught to transform waste materials into useful objects, indirectly learning about sustainability and environmental responsibility. Early environmental education has been proven effective in shaping environmentally friendly behaviors in the future. Ärlemalm-Hagsér (2018) stated that integrating environmental education into early childhood learning significantly enhances children's ecological awareness.

The findings of this study are also consistent with previous research indicating that play-based educational activities enhance fine motor development. For example, Grissmer et al. (2019) found that fine motor skills significantly contribute to children's early academic achievement, highlighting that motor development is not only related to physical abilities but also influences cognitive development. Moreover, recycled-material APE supports inclusive and flexible learning principles. These materials can be adapted to children's individual needs and characteristics, allowing all children to participate actively. Case-Smith et al. (2018) found that individualized interventions significantly improve the effectiveness of fine motor skill development programs, indicating that adaptive learning approaches are essential in early childhood education. In the Indonesian educational context, the use of recycled-material APE is highly relevant. Limited educational resources often become a challenge in providing high-quality learning media. Therefore, innovation in utilizing locally available materials is a practical solution. Suryana (2019) found that the use of local materials in learning activities enhances teacher creativity and student engagement.

Recycled-material APE also fosters children's creativity. Children are not only users of ready-made learning tools but are also involved in the process of creating learning media. This process provides richer and more meaningful learning experiences. Hsin et al. (2017) found that children's involvement in creative processes enhances problem-solving skills and creativity development. Based on the findings, it can be concluded that recycled-material APE is an effective learning strategy for improving early childhood fine motor skills. This effectiveness is supported by several factors, including the manipulative nature of activities, active learning approaches, contextual learning media, and environmental education integration. Therefore, recycled-material APE can serve as an innovative, cost-effective, and sustainable learning alternative in early childhood education. The implications of this study highlight the importance of teachers being more creative in designing learning media and activities. Teachers do not need to rely on expensive learning tools but can utilize materials available in the surrounding environment. In addition, teachers should adopt child-centered learning approaches to ensure active and meaningful learning experiences, leading to more effective and enjoyable learning processes. Future research is recommended to explore the effectiveness of recycled-material APE in other developmental domains such as cognitive, social-emotional, and language development. Furthermore, studies involving larger sample sizes and more complex research designs are needed to enhance the generalizability of the findings.

V. Conclusion

Based on the research findings, it can be concluded that the use of Educational Play Tools (Alat Permainan Edukatif/APE) made from recycled materials is effective in improving early childhood fine motor skills. This is indicated by an increase in the percentage of children achieving the Developing as Expected (BSH) and Very Well Developed (BSB) categories from 25% in the pretest to 83.3% in the posttest. In addition, the N-Gain analysis result of 0.78, which falls into the high category, demonstrates that the intervention has a significant level of effectiveness in enhancing children's fine motor skills. This improvement occurred because learning activities using recycled-material-based APE provided stimulation through manipulative tasks such as cutting, pasting, and stringing beads, all of which involve hand-eye coordination. The learning by doing approach also contributed to increasing children's active engagement during the learning process.

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The implications of this study suggest that recycled-material-based APE can be used as an effective, innovative, and economical alternative learning medium to support the development of fine motor skills in early childhood. Furthermore, the use of recycled materials also adds value by fostering environmental awareness from an early age. This study has limitations, particularly the relatively small number of participants and the absence of a control group. Therefore, future research is recommended to employ a stronger experimental design and involve a larger sample size so that the results can be more widely generalized.

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