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The effect of educational play tools on fine motor development in early childhood education

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Abstract

Background: Fine motor development is a fundamental aspect of early childhood growth that supports children's readiness for academic tasks, self-care, and independent learning. In early childhood classrooms, fine motor stimulation is closely related to the availability and effective use of educational play tools that encourage active manipulation and sensory–motor coordination. However, learning practices often rely on worksheet-based activities, resulting in limited opportunities for hands-on engagement.

Aims: This study aims to examine the effect of educational play tools on the fine motor development of children aged 3–4 years in early childhood education settings.

Method: This study employed a quantitative approach using a pre-experimental one-shot case study design. The participants were 17 children aged 3–4 years at Tresna Asih 3 Kindergarten in Bandar Lampung. The intervention involved structured learning activities using educational play tools, including finger painting, seed-based collage activities, origami manipulation, and patterned cutting tasks. Data were collected through observation instruments measuring fine motor indicators and analyzed using descriptive statistics and one-way analysis of variance.

Results: The findings indicate that educational play tools have a statistically significant effect on children's fine motor development. Among the implemented activities, origami and finger painting showed the strongest contributions to fine motor performance, while cutting activities required higher levels of coordination and readiness. Overall, children demonstrated improved finger control, hand–eye coordination, and fine motor precision following the intervention.

Conclusion: Educational play tools are effective learning media for enhancing fine motor development in early childhood education. Structured play-based activities supported by appropriate teacher facilitation contribute meaningfully to children's fine motor skill development.

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INTRODUCTION

Education in the early years represents a critical phase in supporting children's physical, cognitive, emotional, and social development. Recent perspectives in early childhood education, as discussed by Gunarti (2021) and Tadjuddin, Soleh, and Nopriansyah (2022), emphasize that developmental stimulation should be aligned with children's maturational characteristics and delivered through learning experiences that integrate physical activity, emotional engagement, and meaningful interaction. Such perspectives position early learning as a holistic process in which physical development plays a central role in shaping children's readiness for subsequent educational stages, particularly during the preschool period when basic competencies are rapidly

formed based on developmental psychology principles described by Desmita (2016) and Sunarto (2013).

Fine motor development constitutes a foundational component of early childhood growth because it underpins children's ability to perform academic tasks, self-care activities, and independent learning behaviors. Aguss, Fahrizqi, and Abiyyu (2021) demonstrate that variations in learning environments significantly influence fine motor development in children aged 3–4 years, indicating the importance of structured stimulation during this developmental period. Complementary findings reported by Widayati et al. (2019) show that fine motor skills are closely associated with children's engagement, persistence, and participation during classroom activities, a relationship that aligns with conceptual frameworks of fine motor development outlined by Aulina (2017).

Learning experiences in early childhood classrooms are strongly mediated by instructional media that translate developmental objectives into concrete and observable actions. Jazariyah, Latifah, and Atifah (2021) describe educational play tools as learning media that enable children to explore, manipulate, and construct understanding through direct interaction with materials. Lestari and Safitri (2022) further emphasize that the effectiveness of learning media is closely linked to human factors, particularly teachers' competence in selecting, adapting, and facilitating media use in classroom settings, a view that is consistent with studies on teacher creativity and the development of educational play tools in early childhood education discussed by Wigati and Wiyani (2019).

Educational Play Tools or Alat Permainan Edukatif (APE) are increasingly recognized as tangible learning media that support fine motor development through structured play-based activities. Widayati et al. (2019) explain that APE function as instructional media that integrate sensory and motor experiences, while Jazariyah et al. (2021) highlight their role in sustaining children's motivation and active participation. Studies conducted by Lestariningrum, Nugroho, and Budiarti (2020) and Rahmawati et al. (2020) further illustrate that manipulative activities involving squeezing, arranging, and assembling objects contribute positively to fine motor precision and coordination when guided by teachers, findings that are also reinforced by research on collage-based and manipulative learning media reported by Primayana (2020) and Oktarina et al. (2020).

Specific play-based activities have received increasing scholarly attention in recent years. Cutting activities, as examined by Widayati et al. (2019), are shown to strengthen finger control and visual–motor integration, while Nurjanah et al. (2017) and Nurjani (2019) report that repetitive cutting tasks support gradual improvements in fine motor accuracy as children gain readiness and coordination. Finger painting activities, according to Ramdini and Mayar (2019), also enhance fine motor dexterity while simultaneously fostering creativity and emotional expression, reinforcing the multifunctional value of play-based learning media, a pattern similarly observed in art-based and mosaic activities designed to stimulate fine motor skills as reported by Fauziddin (2018).

Despite the growing body of literature on play-based learning, several research gaps remain evident. Recent studies often focus on single instructional activities without examining the combined use of multiple educational play tools within a unified learning environment, as noted by Widayati et al. (2019). Limited attention has been given to the interaction between instructional media and human factors such as teacher facilitation and children's engagement, as emphasized by Lestari and Safitri (2022). Empirical research from Indonesian early childhood education contexts remains underrepresented in international discussions, particularly studies

that examine fine motor development through tangible, non-digital learning media, as highlighted by Aguss et al. (2021) and Jazariyah et al. (2021).

Preliminary observations conducted at Tresna Asih 3 Kindergarten in Bandar Lampung reveal that several children aged 3–4 years have not yet achieved optimal fine motor development, particularly in activities requiring precision such as cutting, grasping, and object manipulation. Classroom practices were reported to rely predominantly on worksheet-based learning modules, resulting in limited opportunities for hands-on engagement, a condition that reflects instructional challenges previously identified by Lestari and Safitri (2022) in relation to limited media utilization.

This study aims to examine the effect of educational play tools on the fine motor development of children aged 3–4 years at Tresna Asih 3 Kindergarten in Bandar Lampung by focusing on finger painting, seed-based collage activities, origami, and cutting tasks as tangible learning media. This study contributes to early childhood education research by providing empirical evidence on the effectiveness of educational play tools as learning media, offering insights into the role of human factors in mediating learning outcomes, and enriching recent literature with contextual findings from an Indonesian early childhood education setting.

METHOD

This study adopted a quantitative approach with a pre-experimental design to examine the effect of educational play tools on children's fine motor development. A one-shot case study design was employed, in which a single group of participants received an instructional treatment followed by post-intervention observation to assess learning outcomes. This design is commonly used in early-stage educational research to examine the immediate effects of instructional interventions within authentic classroom settings, particularly when random assignment or control groups are not feasible (Sugiyono, 2019). The intervention consisted of structured learning activities using educational play tools, including finger painting, seed-based collage activities, origami manipulation, and patterned cutting tasks. Following the implementation of these activities, children's fine motor performance was observed and recorded as post-intervention data to evaluate the effect of the applied learning media. To clarify the procedural flow of the pre-experimental one-shot case study design, the sequence of research activities from research design, participant involvement, intervention, data collection, observation, to data analysis and research findings is visually presented in Figure 1.

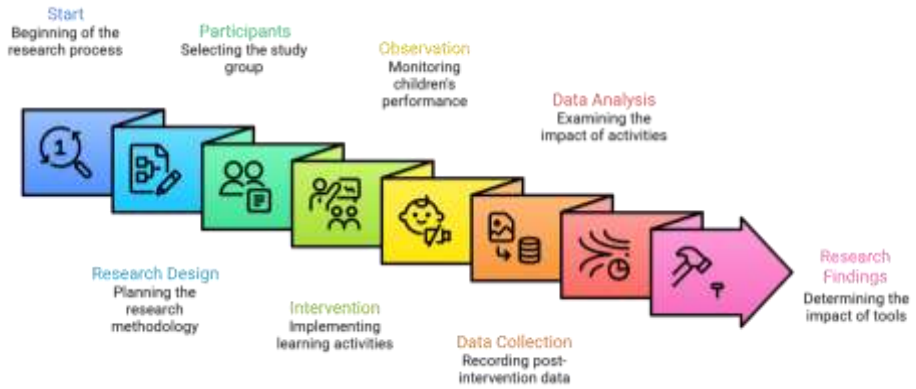

Figure 1. Pre-Experimental Research Procedure for Fine Motor Development

The research was conducted during the second semester of the 2022–2023 academic year at Tresna Asih 3 Kindergarten in Bandar Lampung. All children enrolled in Class A participated in the study, resulting in a total of 17 children aged 3–4 years. A saturated sampling technique was applied, in which the entire population was used as the research sample due to the small number of participants. This sampling strategy is appropriate in early childhood classroom research where the population size is limited and the goal is to capture real instructional conditions experienced by all learners (Sugiyono, 2019).

Data were collected using a structured observational instrument designed to measure fine motor development in early childhood. The observation checklist covered key fine motor indicators, including squeezing and tearing origami paper, pinching and transferring seeds into containers, collage activities within defined boundaries, mixing and applying paint colors, and cutting along various patterns. Children's performance was assessed using a three-level developmental scale representing limited, adequate, and very good achievement. The instrument was developed based on established theoretical frameworks of fine motor development and validated through expert judgment to ensure content and construct appropriateness, as recommended in early childhood assessment practices (Gunarti, 2021). Item validity was examined using product-moment correlation analysis, and instrument reliability was tested through internal consistency procedures to ensure measurement accuracy.

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics were used to summarize children's fine motor development following the intervention. Prior to hypothesis testing, prerequisite analyses were conducted to examine data distribution and variance characteristics. Normality was assessed using the Shapiro–Wilk test, and homogeneity of variance was evaluated to confirm the suitability of parametric analysis. Hypothesis testing was performed using one-way analysis of variance to determine whether the use of educational play tools had a statistically significant effect on children's fine motor development. All statistical analyses were conducted using SPSS software with a significance level of 0.05.

RESULT AND DISCUSSION

The study was conducted at Tresna Asih 3 Kindergarten in Bandar Lampung during the second semester of the 2022–2023 academic year. A total of 17 children aged 3–4 years participated in structured learning activities using educational play tools. Data analysis focused on the quality of the research instrument and the statistical effect of educational play tools on children's fine motor development.

Instrument reliability was examined to ensure the consistency of the observation data. The reliability analysis yielded a Cronbach's Alpha value of 0.862 across 20 valid observation items, indicating high internal consistency and confirming that the instrument was reliable for measuring fine motor development in early childhood learners.

Table 1. Instrument Reliability Analysis

Measure	Value
Cronbach's Alpha	0.862
Number of Items	20

Descriptive analysis of post-intervention data showed that children demonstrated measurable fine motor engagement across all educational play tools, including origami activities, seed-based collage tasks, finger painting, and patterned cutting. Although variations were

observed across activity types, the overall pattern indicated that educational play tools supported fine motor skill development in the classroom context.

Prior to hypothesis testing, assumption testing was conducted to examine data suitability for inferential analysis. Normality and homogeneity checks were performed as part of the analytical procedure to support the use of parametric testing. The results of these prerequisite analyses indicated that the data could be further analyzed to examine group differences in fine motor outcomes.

Hypothesis testing was conducted using one-way analysis of variance to examine whether educational play tools had a significant effect on children's fine motor development. The analysis revealed a statistically significant difference among the educational play tools, indicating that the type of play-based learning media influenced fine motor performance.

Table 2. One-Way ANOVA Results of Educational Play Tools on Fine Motor Development

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3186.176	3	1062.059	345.550	.000
Within Groups	196.706	6	3.074		
Total	3382.882	67			

The one-way ANOVA results demonstrate a statistically significant effect of educational play tools on children's fine motor development ($F = 345.550, p < .001$). These findings provide empirical evidence that the implementation of educational play tools contributes meaningfully to fine motor skill development in early childhood learning environments. To further interpret the statistical findings, the following discussion elaborates on how the observed effects of educational play tools can be understood within the context of early childhood learning and existing theoretical perspectives.

The findings of this study indicate that educational play tools have a statistically significant effect on the fine motor development of children aged 3–4 years at Tresna Asih 3 Kindergarten. This result supports the perspective of early childhood learning as a process grounded in developmentally appropriate stimulation that integrates physical activity and meaningful interaction, as emphasized by Gunarti (2021) and Tadjuddin, Soleh, and Nopriansyah (2022). In addition, the significant ANOVA results align with empirical evidence reported by Widayati et al. (2020), who highlight the effectiveness of hands-on learning media in improving fine motor performance in early childhood classrooms.

The descriptive results reveal that origami-based activities produced the highest mean scores among the educational play tools examined. Origami activities involve repetitive squeezing, tearing, folding, and shaping actions that actively engage small muscle groups in the fingers and hands. These findings are consistent with the work of Lestariningrum, Nugroho, and Budiarti (2020), who report that manipulative paper-based activities strengthen fine motor precision and hand–eye coordination when children are guided through structured tasks. Furthermore, similar outcomes regarding the continued effectiveness of paper-based manipulative tasks in early childhood settings, even amid increasing digital exposure, have been documented by Rahmawati and Nurwuni (2022).

Finger painting activities also showed a strong contribution to fine motor development by encouraging controlled finger movements, color mixing, and tactile exploration. Support for this finding is provided by Ramdini and Mayar (2019), who argue that finger painting enhances fine motor dexterity while simultaneously fostering creativity and emotional expression. More recent studies by Aguss et al. (2022) further suggest that tactile art activities strengthen sensory–motor

integration and emotional engagement, which are critical components of early fine motor development. This pattern is reinforced by observations reported by Widayati et al. (2020), who emphasize that learning media stimulating both sensory and motor systems promote sustained participation and learning persistence in early childhood classrooms.

Seed-based collage activities, including inserting seeds into containers and arranging materials on images, were found to support fine motor coordination through precision grasping and visual–motor integration. This finding is in line with Jazariyah, Latifah, and Atifah (2021), who emphasize that educational play tools enable children to actively manipulate materials and construct understanding through direct interaction. Additional evidence regarding the effectiveness of collage-based activities in facilitating fine motor control, particularly when supported by appropriate teacher scaffolding and feedback, is provided by Primayana (2020) and further elaborated in recent discussions by Lestari et al. (2023).

Cutting activities using patterned scissors demonstrated a significant but comparatively lower mean performance. Cutting tasks require higher levels of coordination, concentration, and bilateral hand control, which may explain the variation observed among children. This explanation corresponds with findings reported by Widayati, Adhe, Nafisa, and Silvia (2019) and Nurjani (2019), who describe cutting skills as developing gradually according to children's readiness and task complexity. Additional confirmation of this gradual development process is offered by Nurhidayat et al. (2020), who emphasize that repeated exposure within guided play-based contexts supports progressive improvement in cutting proficiency.

Beyond the instructional media themselves, the findings highlight the importance of human factors in mediating learning outcomes. Teacher facilitation played a central role in guiding children's interaction with educational play tools, maintaining engagement, and providing appropriate scaffolding during activities. This observation supports the argument advanced by Lestari and Safitri (2022), who stress that the effectiveness of learning media is closely linked to teachers' competence in selecting, adapting, and facilitating instructional materials. Further reinforcement of the role of teacher mediation in amplifying the developmental impact of play-based learning media is provided in broader educational analyses discussed by OECD (2021).

The results of this study address several gaps identified in recent literature. While many previous studies focus on single play-based activities in isolation, this research demonstrates the combined effect of multiple educational play tools within a unified classroom setting, as suggested by Widayati et al. (2020). Moreover, the study contributes empirical evidence from an Indonesian early childhood education context, which remains underrepresented in international discussions on fine motor development, as noted by Aguss, Fahrizqi, and Abiyyu (2021). In this regard, the present findings align with broader calls for increased representation of context-specific early childhood research in global academic discourse, as emphasized by UNESCO & Unicef (2024).

Despite these contributions, the findings should be interpreted with caution. The use of a one-shot case study design without a control group limits causal generalization, and the relatively small sample size restricts broader inference. In line with recommendations articulated by Gunarti (2021) and further reinforced by Tadjuddin et al. (2022), future studies are encouraged to employ experimental or quasi-experimental designs with larger samples to further investigate the comparative effectiveness of specific educational play tools and the moderating role of teacher facilitation.

CONCLUSIONS

This study aimed to examine the effect of educational play tools on the fine motor development of children aged 3–4 years at Tresna Asih 3 Kindergarten in Bandar Lampung. The findings demonstrate that educational play tools, including finger painting, seed-based collage activities, origami manipulation, and patterned cutting tasks, have a statistically significant effect on children's fine motor development. The results of the one-way ANOVA confirm that structured play-based learning media contribute meaningfully to the development of finger control, hand–eye coordination, and fine motor precision. These findings reinforce the importance of developmentally appropriate learning experiences that integrate physical activity and sensory engagement, while also highlighting the role of educational play tools as effective non-digital learning media in early childhood classrooms.

The findings suggest important implications for early childhood education practice, particularly the need for teachers to integrate varied educational play tools into daily learning activities and to actively facilitate children's engagement during play-based learning. The effectiveness of educational play tools is closely linked to human factors, especially teacher guidance and classroom interaction, indicating that learning media alone are insufficient without supportive instructional practices. At the same time, the findings should be interpreted with caution due to the use of a pre-experimental design, a limited sample size, and the focus on a single educational setting. Future research is therefore encouraged to employ more rigorous experimental designs, larger samples, and longer intervention periods to further investigate the comparative effectiveness of educational play tools and the interaction between learning media and human factors in supporting early childhood fine motor development.

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AUTHOR CONTRIBUTION STATEMENT

NKP was responsible for research conceptualization, research design, data collection and DNH was responsible for data analysis, interpretation of results, and manuscript writing. The authors has read and approved the final version of the manuscript.

CONFLICTS OF INTEREST

The authors declares that this study involved the use of educational play tools solely for instructional and research purposes. There were no financial sponsorships, commercial interests, or personal relationships that could be perceived as influencing the research outcomes or their interpretation.

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