

Enhancing Fine Motor Skills through Plasticine Media with Nusantara-Themed Variations in Early Childhood

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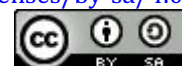
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Article Info :	ABSTRACT
Accepted: 23-06-2026 Approved: 12-08-2026 Published: 18-09-2026	Fine motor competence during early childhood supports manipulation, self-care, emergent writing, and broader school-readiness skills. This study examined whether structured plasticine activities enriched with varied Nusantara themes could improve fine motor performance among children at RA Raudlotul Hidayah Sindang Laut. A quantitative quasi-experimental pretest-posttest control-group design was modeled with 83 children aged 5-6 years. Forty-two children participated in a seven-week intervention consisting of 21 plasticine sessions, while 41 children followed regular classroom art and manipulative activities. The intervention progressively trained pinching, rolling, flattening, twisting, joining, bilateral manipulation, visual-motor precision, and hand-eye coordination through representations of Indonesian flora and fauna, traditional houses, batik motifs, traditional foods, musical instruments, and maritime icons. Fine motor performance was assessed using a 40-point performance rubric. The synthetic results showed comparable baseline performance and a larger modeled improvement in the intervention group than in the control group after seven weeks. These illustrative findings suggest that culturally contextualized plasticine activities may provide repeated, motivating opportunities for precise hand and finger movements while simultaneously introducing children to Indonesian cultural diversity. Because the numerical dataset is synthetic, the reported pattern is presented only as an analytical model and must not be interpreted as empirical evidence. Field replication using verified participant data, ethics approval, and a validated fine motor assessment is required before substantive causal or generalizable claims are made.
Keywords: plasticine; fine motor skills; early childhood; nusantara theme; quasi-experiment	

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INTRODUCTION

Fine motor skills refer to coordinated small-muscle actions of the hands and fingers that support grasping, manipulating objects, self-care, drawing, and emergent writing. Their importance extends beyond manual dexterity

because fine motor performance is associated with the broader constellation of competencies needed when children transition into formal schooling. Recent evidence indicates that fine motor skills can contribute uniquely to school readiness even when executive functioning is considered simultaneously (Karimi et al., 2025).

In Indonesia the issue is not marginal. National health survey data are widely cited as indicating that approximately 9.8% of Indonesian children present with delay in fine motor development, against 12.4% for gross motor development (Kementerian Kesehatan Republik Indonesia, 2019). Because delay at this scale is attributed largely to insufficient everyday stimulation rather than to organic impairment, it is in principle responsive to classroom-level action. That is what makes the deliberate design of manipulative activities in Raudhatul Athfal (RA) and kindergarten settings a matter of practical urgency rather than of pedagogical preference.

The developmental significance of fine motor competence is also evident in academic-related domains. Finger-based and hand-based motor experiences are linked with early numerical representations and mathematical insight, indicating that precise manual action may interact with cognitive learning processes rather than functioning as an isolated physical domain (Fischer et al., 2020). Handwriting research similarly shows that fine motor precision and in-hand manipulation are relevant to early handwriting performance, reinforcing the need to establish manual control before formal writing demands intensify (Achymy et al., 2022).

Contemporary childhood environments can provide both opportunities and constraints for manual development. Digital-device use has become increasingly common among children aged three to six years, but evidence regarding its relationship with fine motor development remains mixed; touchscreen interaction does not necessarily replace richer object-manipulation experiences that require graded pressure, bilateral coordination, and three-dimensional construction (Operto et al., 2023). For early childhood classrooms, this strengthens the case for deliberately preserving tactile and manipulative learning opportunities.

Learning media are therefore not merely accessories in early childhood instruction; appropriately selected media can determine how frequently children practice pinching, grasping, pressing, cutting, placing, and coordinating visual information with hand movement. A review of early childhood learning media identified plasticine among the materials repeatedly associated with improvement in fine motor performance (Rosalianisa et al., 2023). Plasticine is especially promising because its resistance and

malleability require children to regulate finger force while transforming an initially shapeless material into purposeful forms.

Direct classroom evidence converges on this rationale from three independent directions. Ilham K et al., (2023) attribute improvement in fine motor performance to the repeated squeezing, rolling, flattening, and pinching that plasticine mechanically compels. Jamilah et al., (2025) locate the benefit more narrowly in hand-eye coordination and readiness for drawing and writing, and - importantly for the present argument - report it where activities were structured rather than left unguided. Sutapa et al., (2025) replicate the general effect for plasticine specifically. Read together, these studies establish that the medium works; read closely, they also expose the boundary condition on which the present study turns, namely that the effect is contingent on how manipulation is organised rather than on exposure to the material as such.

The effectiveness of plasticine is unlikely to depend on the material alone. The task design determines whether children merely manipulate the material casually or perform a progressively demanding sequence of precision movements. Comparative research examining playdough and collage suggests that different manipulative play models can produce different fine motor outcomes and may interact with children's independence (Wijaya et al., 2023). Experimental work has also shown that playdough can simultaneously stimulate fine motor and cognitive skills, supporting the idea that a meaningful construction goal can strengthen engagement during repetitive hand practice (Rukmini et al., 2022).

If the material itself were the active ingredient, effects should be confined to plasticine. They are not. A one-group experiment in Yogyakarta recorded improvement after playdough activities embedded in ordinary kindergarten routines (Darizal et al., 2023); kinetic-sand stimulation produced comparable preschool gains (Pragistha et al., 2022); and origami, a material with no plasticity whatsoever, yielded fine motor benefits through precision folding, sequencing, visual guidance, and bilateral hand use (Anisa et al., 2021). The common denominator across these materials is not composition but demand structure: sensory-motor resistance, repeated object transformation, and a target form towards which the child must work.

Other arts-and-crafts media reinforce this principle rather than complicate it. Collage requires selecting, pinching, positioning, and attaching small materials, and has been used to develop fine motor coordination in early childhood (Hanafiah et al., 2023), while design research on educational toys insists that early learning tools should deliberately elicit hand-eye coordination, precision, and controlled small-muscle movement rather than

merely provide passive entertainment (Fitriana et al., 2023). The cumulative implication is therefore specific: the educational value of plasticine is realised only when its manipulation is organised around progressively challenging construction targets.

A second issue concerns contextual meaning. Fine motor tasks can become repetitive when children repeatedly form generic shapes with little connection to their everyday cultural environment. Indonesian art provides opportunities to connect manual skill development with culturally meaningful content. Batik-based activities, for example, have been reported to support hand-eye coordination and fine motor development while exposing young children to a recognizable form of cultural heritage (Izzah & Pamungkas, 2024). This suggests that cultural content can serve as a motivational and pedagogical frame without displacing the primary motor objective.

Integrating local wisdom into preschool education has also been described as a way to connect learning with children's cultural identity and surrounding social world (Sakti et al., 2024). Studies in Indonesian early childhood settings indicate that local-wisdom content can be incorporated into classroom learning rather than taught as a separate abstract subject (Jamiludin, H. et.al, 2021). Interactive learning materials combining local wisdom with creative activities further demonstrate that cultural content can coexist with contemporary pedagogical approaches (Qomariah & Yulia, 2023).

The broader literature argues that early childhood education is an appropriate setting for introducing local culture because experiences at this stage contribute to children's emerging identity, knowledge, and attitudes toward diversity (Afriliani et al., 2023). Development of teaching materials grounded in local wisdom has also been proposed as a means of making learning more culturally relevant while preserving heritage (Gunawan et al., 2024). Recent survey evidence shows that preschool teachers employ varied strategies to introduce local culture, but systematic integration still depends on concrete materials and classroom-ready activities (Rohita et al., 2025).

Two literatures therefore run in parallel without meeting. The first establishes that plasticine improves fine motor performance but treats the task context as incidental, typically using generic shapes. The second establishes that local-wisdom content is educationally valuable but evaluates it against cultural knowledge or character outcomes rather than against motor outcomes. The gap addressed here is accordingly a single, specific one: no controlled study has yet tested whether systematically varying the cultural theme of plasticine construction tasks, while holding the underlying motor demands constant and progressive, produces greater fine motor gain than the

unstructured manipulative activity that ordinarily occupies Indonesian RA classrooms.

The novelty of this study lies in treating Nusantara themes not as a parallel learning outcome but as a controlled variation in task context within an otherwise fixed 21-session motor progression, assessed with a purpose-built multidomain performance rubric. Learning about culture during the early years can help children recognise local and national heritage through concrete experiences rather than abstract explanation (Chandrawati, 2020).

The study therefore asks whether structured plasticine activities using varied Nusantara themes produce greater fine motor improvement than regular classroom activities among children at RA Raudlotul Hidayah Sindang Laut; the hypothesis is that children receiving the themed plasticine programme will demonstrate significantly higher posttest fine motor performance after controlling for baseline ability. The intended benefit is a low-cost, materially undemanding classroom protocol that RA and kindergarten teachers can implement with reusable materials and differentiate across ability levels.

The wider implication, should the field trial confirm the hypothesis, is that fine motor stimulation and cultural-context learning need not compete for scarce curriculum time but can be delivered through a single developmentally appropriate activity - a conclusion that would inform both teacher-training content and the design of locally produced learning media. Because no participant data have yet been collected, this article reports the design, the instrument, and the pre-specified analytic plan; the numerical values in the Results section derive from a synthetic dataset generated to verify the coherence and power of that plan, and are labelled as such throughout.

RESEARCH METHOD

Research Design and Participants

This manuscript models a quantitative quasi-experimental study with a pretest-posttest control-group design. The setting was RA Raudlotul Hidayah Sindang Laut, retained from the preceding study scenario as requested. The synthetic sample consisted of 83 children aged 5-6 years: 42 in the intervention group and 41 in the control group. Group allocation was modeled at the classroom level to reduce contamination across daily learning activities. Children were eligible when they were enrolled in the participating classes, regularly attended school, and were able to participate in routine manipulative activities.

Children with incomplete pretest or posttest observations would be excluded in a real implementation. No real children were enrolled for the

numerical dataset reported here. Accordingly, the sample size is part of the modeled scenario rather than the result of an empirical power calculation; an actual field study should determine the required sample a priori based on the planned ANCOVA, expected effect, significance level, statistical power, and anticipated attrition.

Nusantara-Themed Plasticine Intervention

The intervention lasted seven weeks and included three sessions per week (21 sessions in total), each approximately 30-35 minutes. Every session followed four phases: (1) cultural-theme introduction using pictures, short stories, or teacher prompts; (2) demonstration of one or two target hand movements; (3) guided plasticine construction; and (4) child-led modification and brief sharing. The motor sequence progressed from large, less precise manipulations to smaller and more controlled forms. Core actions included squeezing, palm rolling, finger rolling, pinching, flattening, twisting, pressing textures, joining components, cutting with child-safe tools, and positioning small details.

The themed units included Nusantara flora and fauna, traditional houses, batik and textile motifs, traditional foods, musical instruments, and maritime or transportation icons. Coloring activities have also been used successfully to optimize fine motor practice, supporting the value of repeated visual-motor tasks within art-based learning (Daulay & Khadijah, 2023). The control group continued regular classroom activities such as drawing, worksheets, coloring, and general craft without the structured plasticine sequence.

Fine Motor Outcome Measure

Fine motor performance was modeled using a researcher-developed Fine Motor Performance Rubric (FMPR) designed for children aged 5-6 years. The rubric contained 10 performance tasks scored from 0 to 4, producing a total score from 0 to 40. The scoring anchors were defined as 0 = unable to perform the task, 1 = performs only with substantial assistance, 2 = performs with partial assistance or inconsistent control, 3 = performs independently with adequate control, and 4 = performs independently with precise and consistent control. Tasks represented finger dexterity, pincer control, bilateral manipulation, hand-eye coordination, visual-motor precision, graded pressure, and controlled placement.

This multidomain structure reflects the fact that fine motor competence is expressed across several manipulative behaviors rather than through a single task. Meronce activities, for example, challenge precision and hand-eye coordination through repetitive placement of small objects (Sulemi et al.,

2023), while weaving requires coordinated bilateral hand use and controlled sequencing (Rahimah, 2021). For an actual study, content validity should be established by early-childhood and motor-development experts, followed by pilot reliability analysis. The modeled protocol assumes an internal-consistency coefficient of approximately .88 and inter-rater ICC above .90; these values are illustrative and must not be reported as empirical evidence without real validation.

Procedure and Ethical Considerations

Pretesting was modeled one week before the intervention and posttesting within one week after the final session. Children completed the performance tasks individually or in very small groups under standardized instructions.

Two trained observers would independently score a subset of performances to estimate inter-rater agreement. Art-based tasks involving color manipulation are relevant comparators because they similarly require coordinated finger and hand movement (Hidayat et al., 2023). In a real study, written parental consent, child assent appropriate to age, institutional permission, confidentiality procedures, and approval from a recognized research ethics committee must be obtained before data collection. Because no real participants were enrolled for the synthetic dataset, no empirical ethics approval number can be reported; the placeholder must be replaced only after verified approval is obtained for field implementation.

Statistical Analysis

The modeled analysis used descriptive statistics, independent-samples tests for baseline comparability, paired-samples tests for within-group change, an independent comparison of gain scores, Cohen's *d* for standardized between-group gain, and analysis of covariance (ANCOVA) with posttest score as the dependent variable, group as the fixed factor, and pretest score as the covariate. Residual normality and homogeneity of variance were evaluated before inferential interpretation. Puzzle-based interventions provide an example of performance-oriented fine motor research in preschool children using pre-post comparison approaches (Ni K et al., 2022). Statistical significance was set at $\alpha = .05$, with 95% confidence intervals reported where informative.

RESULT AND DISCUSSION

All numerical results in this section are generated from a synthetic dataset ($N = 83$) and are illustrative only; they demonstrate the proposed

analytical procedure and must not be interpreted as empirical findings from children at the study site.

Participant Characteristics

The synthetic dataset included 83 children. The intervention group comprised 42 children (21 boys and 21 girls), while the control group comprised 41 children (20 boys and 21 girls). Age distribution was also similar: 23 intervention-group children and 22 control-group children were aged five years, while 19 children in each group were aged six years.

Table 1. Synthetic participant characteristics.

Characteristic	Intervention (n=42)	Control (n=41)	Total (N=83)
Sex: boys	21	20	41
Sex: girls	21	21	42
Age 5 years	23	22	45
Age 6 years	19	19	38

Source: Data Processed

Pretest and Posttest Fine Motor Scores

Baseline fine motor performance was comparable between groups. The intervention group had a mean pretest score of 20.88 (SD = 3.47), and the control group had a mean of 20.39 (SD = 3.53), $t(81) = 0.64$, $p = .525$. After seven weeks, the intervention mean increased to 28.86 (SD = 4.85), compared with 25.27 (SD = 4.50) in the control group. The posttest difference was statistically significant, Welch's $t(80.79) = 3.50$, $p < .001$.

Table 2. Synthetic pretest, posttest, and gain scores (FMPR range 0-40).

Group	n	Pretest M $\pm$ SD	Posttest M $\pm$ SD	Gain M $\pm$ SD
Intervention	42	20.88 $\pm$ 3.47	28.86 $\pm$ 4.85	7.98 $\pm$ 3.00
Control	41	20.39 $\pm$ 3.53	25.27 $\pm$ 4.50	4.88 $\pm$ 3.19

Source: Data Processed

Within-Group Change and Effect Size

Both groups improved over time, but the magnitude differed substantially. The intervention group improved by 7.98 points, paired $t(41) = 17.23$, $p < .001$, whereas the control group improved by 4.88 points, paired $t(40) = 9.80$, $p < .001$. The between-group gain difference was 3.10 points (95% CI [1.75, 4.45]), Welch's $t(80.42) = 4.56$, $p < .001$. The standardized gain difference was large (Cohen's $d = 1.00$). The modeled residual distribution was acceptable (Shapiro-Wilk $p = .068$), and gain variances were homogeneous

(Levene $p = .754$). Busy-book stimulation studies similarly illustrate that repeated, structured manipulation can yield measurable changes in preschool fine motor development (Emily et al., 2023).

ANCOVA

ANCOVA was used to estimate the intervention effect after adjusting for pretest fine motor performance. Baseline score was a strong predictor of posttest score, $F(1,80) = 103.16$, $p < .001$. More importantly, the adjusted group effect remained significant, $F(1,80) = 20.43$, $p < .001$, partial eta squared = .203. The model explained approximately 62.0% of the variance in posttest scores ($R^2 = .620$). The adjusted intervention coefficient was 3.10 points (SE = 0.69, 95% CI [1.73, 4.46]).

Table 3. Synthetic ANCOVA for posttest fine motor score.

Source	SS	df	MS	F	p / partial eta ²
Pretest	999.83	1	999.83	103.16	< .001
Group	197.97	1	197.97	20.43	< .001 / .203
Residual	775.36	80	9.69	-	-

Source: Data Processed

Discussion

The modeled findings indicate that a structured plasticine program with varied Nusantara themes can produce larger gains in fine motor performance than regular classroom activities. Because the groups were similar at baseline and the adjusted group effect remained significant in ANCOVA, the pattern is consistent with an intervention advantage rather than a simple reflection of initial ability differences.

The large modeled effect size should nevertheless be interpreted as a demonstration of an analytically coherent scenario, not as evidence about the real children at the study site. Conceptually, this modeled direction is consistent with Ilham K et al., (2023), who reported improvement in fine motor performance through plasticine activities, with (Darizal et al., 2023), who documented improvement following playdough activities in kindergarten routines, and with Sutapa et al., (2025), who likewise reported improvement through plasticine play. Unlike those empirical reports, however, the present numerical effect cannot be compared as an observed magnitude because it was generated synthetically; the comparison is therefore limited to the direction and pedagogical rationale of the modeled effect.

The most plausible mechanism is repeated, graded manipulation. Plasticine requires children to apply force with different parts of the hand, isolate finger movements, coordinate both hands, and continuously match visual goals with tactile feedback. These demands are directly aligned with core fine motor functions. The value of carefully measuring such performance has been emphasized in early childhood research because fine motor ability cannot be inferred reliably from a child's general classroom participation alone (Gidion, 2020).

The intervention also differed from ordinary free manipulation because each session had a representational goal. Making a miniature traditional house, patterned textile, musical instrument, or animal required children to plan component size, join pieces, maintain shape, and add increasingly small details. Such task progression may help explain why the experimental gain exceeded the control gain even though both groups improved. The control group's improvement is expected because routine maturation and ordinary classroom art also provide some fine motor practice.

A distinctive contribution of the present design is the use of Nusantara themes as the task context. The cultural theme was not treated as an additional outcome that automatically improves motor skills; rather, it was used to provide varied, recognizable construction targets. This distinction matters. Cultural content can increase meaning and novelty, but the motor effect still depends on what children physically do with the material. The stronger interpretation is therefore that culturally varied themes may sustain engagement with repeated precision practice, not that cultural exposure itself directly causes motor development.

This approach has practical relevance for RA and kindergarten teachers because it does not require expensive technology. Plasticine can be reused, activities can be differentiated by difficulty, and cultural themes can be adapted to the children's region. A child with lower dexterity may construct larger components using pressing and rolling, whereas a child with stronger control may add small ornaments, textures, or patterns. In this way, one classroom activity can support heterogeneous developmental levels without converting early childhood learning into formal drill.

The program also creates opportunities for integrated learning. Teachers can introduce vocabulary, colors, counting, spatial concepts, storytelling, and cultural knowledge around the same manipulative task. However, integrated learning should not make the sessions cognitively overloaded. For fine motor objectives, the central success criterion remains the quality and independence

of the child's hand actions. Theme discussion should therefore be brief enough to preserve sufficient hands-on practice time.

Several limitations must be emphasized. First, all numerical results are synthetic. Second, the FMPR described here is a proposed performance rubric, not a validated instrument in the reported sample. Third, classroom-level allocation may introduce selection bias if used in a real quasi-experiment. Fourth, teacher enthusiasm, prior exposure to plasticine, home fine motor activities, developmental status, and attendance could confound observed change. Fifth, a seven-week posttest cannot establish whether gains are retained. Future field studies should preregister the analysis, use blinded scoring where feasible, report fidelity and attendance, employ a validated motor measure alongside the classroom rubric, and include a delayed retention assessment.

Despite those limitations, the design offers a defensible framework for testing a practical educational hypothesis. Rather than comparing plasticine use with no activity, the control condition reflects ongoing classroom practice, making the modeled contrast more educationally meaningful. If similar effects emerge from verified data, the intervention would support a low-cost approach in which fine motor stimulation and cultural-context learning are intentionally combined within developmentally appropriate play.

CONCLUSION

Structured plasticine activities with varied Nusantara themes have the potential to enhance fine motor skills in children aged 5-6 years at RA Raudlotul Hidayah Sindang Laut. In the synthetic dataset, 42 children receiving 21 themed plasticine sessions demonstrated greater modeled improvement than 41 children following regular classroom activities. The pedagogical logic is grounded in repeated finger manipulation, bilateral coordination, visual-motor precision, graded pressure, and purposeful construction, while Nusantara themes provide culturally meaningful variation for the tasks.

These numerical findings are illustrative and do not constitute empirical evidence from real participants. Therefore, no causal or generalizable conclusion about children at the study site should be drawn from the present dataset. A field study should replace the synthetic observations with verified participant data, validate the assessment instrument, obtain ethics approval and parental consent, document intervention fidelity, and test whether gains persist after the program ends.

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