

The Dynamics of Children's Fine Motor Skill Development: Evaluating the Effectiveness of Natural Material-Based Collage Activities

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KEYWORDS	ABSTRACT
Keywords: Collage; Fine Motor Skills; Natural Materials; Early Childhood. Conflict of Interest Statement: The author(s) declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. Copyright ©2026 Vifada Management and Digital Business. All rights reserved.	Purpose: This study aims to examine the effect of natural-material collage activities on the fine motor skills of children aged 5-6 years in Group B. Research Method: This study employed a quantitative approach using a one-group pretest-posttest design. The participants were 15 children enrolled in Group B during the second semester of the 2025/2026 academic year. Data were collected through observation, documentation, and performance assessments and analyzed using a paired-samples t-test. Results and Discussion: Following the intervention, 60.00% of the children achieved the Very Well Developed (BSB) category in hand-eye coordination, while 53.34% reached the Developing as Expected (BSH) category in both manipulative movements and finger flexibility. The paired-samples t-test revealed a statistically significant difference between pretest and posttest scores, $t(14) = 11.515$, $p < .001$, indicating a significant improvement in children's fine motor skills following the intervention. Implications: The findings suggest that natural-material collage activities can serve as an engaging and accessible instructional strategy for enhancing fine motor development in early childhood education. The use of readily available natural materials also supports the integration of locally sourced learning resources into classroom activities. Originality: This study contributes empirical evidence regarding the effectiveness of natural-material collage activities in improving children's fine motor skills, particularly across three developmental dimensions: hand-eye coordination, manipulative movements, and finger flexibility.

1) Introduction

Early childhood, particularly between the ages of 0 and 6 years, is a critical period for developing cognitive, physical, motor, language, and socio-emotional abilities. During this stage, children learn primarily through direct interaction, exploration, and play. Therefore, developmentally appropriate learning activities are essential for strengthening foundational skills. [Rosalianisa et al. \(2023\)](#) highlight the importance of appropriate learning media in stimulating children's fine motor development, while [Damayanti et al. \(2022\)](#) emphasize the contribution of structured play to early childhood development.

Fine motor skills involve the coordinated movement of small muscles, particularly those in the hands and fingers, to perform tasks requiring precision, flexibility, and hand-eye coordination. These skills support daily activities and school readiness, including writing, drawing, cutting, and manipulating objects. Children aged 5-6 years are expected to demonstrate increasing control over

these movements. However, inadequate stimulation may limit their ability to perform tasks requiring precise hand and finger coordination ([Mustiani et al., 2023](#); [Nugraheni et al., 2021](#)).

Preliminary observations at RA Al-Ikhlâs Birobuli Selatan, Palu City, revealed several fine motor difficulties among Group B children. Some children struggled to cut along predetermined patterns, apply glue neatly, position materials accurately, and maintain a stable pencil or crayon grip. These difficulties indicate a need for learning activities that specifically strengthen hand-eye coordination, manipulative movements, and finger flexibility through repeated practice.

Natural material-based collage activities offer a practical approach to addressing these difficulties. Collage involves selecting, grasping, arranging, and attaching materials to a designated surface to create visual compositions ([Wahyuni et al., 2024](#)). Using dried leaves, seeds, corn husks, and small twigs exposes children to materials with different shapes, sizes, and textures. Manipulating these materials requires controlled finger movements, precise positioning, and hand-eye coordination. Previous studies have reported improvements in children's fine motor skills following collage activities using natural materials ([Sidabutar & Siahaan, 2019](#); [Hasnawati et al., 2021](#); [Aripin et al., 2022](#)).

Recent studies have also highlighted the potential of natural material-based collage activities to support fine motor development (Sukandar et al., 2024; Fadhli et al., 2024; Vebriyanti et al., 2026). However, the findings of these studies do not establish how children's fine motor performance changes within the specific learning context of RA Al-Ikhlâs Birobuli Selatan. In particular, evidence is needed regarding three measurable dimensions: hand-eye coordination, manipulative movements, and finger flexibility. Examining these dimensions provides a more specific assessment of children's fine motor development following collage activities.

Accordingly, this study aims to examine changes in the fine motor skills of Group B children aged 5-6 years at RA Al-Ikhlâs Birobuli Selatan, Palu City, following participation in natural material-based collage activities. Using a quantitative one-group pretest-posttest design, the study evaluates differences in fine motor performance before and after the intervention. The findings are expected to provide context-specific empirical evidence to inform the use of accessible natural materials in early childhood learning activities.

2) Literature Review and Hypothesis Development

Collage activities represent a form of creative, hands-on learning that engages children in a series of coordinated movements, including grasping, pinching, applying adhesive, arranging materials, and attaching them to a designated surface. These activities require hand-eye coordination, finger dexterity, movement precision, and sustained attention, all of which are essential components of fine motor development. Beyond fostering creativity and artistic expression, collage activities provide opportunities for children to strengthen their fine motor skills through repeated manipulation of materials and purposeful hand movements ([Sholikhah, 2023](#); [Wahyuni et al., 2024](#); [Nur Insana et al., 2022](#)).

According to [Agysni and Alfariyah \(2024\)](#) and [Sholikhah \(2023\)](#), collage is an artistic technique that involves combining and attaching various materials to a surface to create a unified visual composition. As a form of visual art, collage emphasizes the arrangement of diverse elements into a harmonious and meaningful artistic product. The materials used in collage activities may include manufactured, recycled, and natural materials, each offering distinct opportunities for sensory exploration and creative engagement. In particular, natural materials provide varied textures, shapes, and sizes that encourage children to engage in different forms of grasping, manipulating, positioning, and attaching objects. Such experiences may support the development of hand-eye coordination, manipulative abilities, and finger flexibility.

From a developmental perspective, natural material-based collage activities may facilitate fine motor development by providing opportunities for children to perform increasingly precise and coordinated hand movements. The process of selecting, handling, arranging, and attaching natural materials requires the integration of visual perception and motor control. Repeated engagement in these activities may strengthen children's ability to coordinate finger movements, regulate hand pressure, and manipulate small objects with greater accuracy. Accordingly, natural material-based

collage activities can be conceptualized as a developmentally appropriate learning strategy that integrates artistic creativity, sensory exploration, and fine motor stimulation.

Drawing on the theoretical perspectives and previous empirical findings discussed above, this study examines changes in children's fine motor skills following participation in natural material-based collage activities. The following hypotheses are proposed:

H₀ (Null Hypothesis): There is no statistically significant difference in children's fine motor skill scores before and after participation in natural material-based collage activities.

H₁ (Alternative Hypothesis): There is a statistically significant difference in children's fine motor skill scores before and after participation in natural material-based collage activities.

3) Research Method

This study employed a quantitative approach using a pre-experimental one-group pretest-posttest design. The design involved assessing children's fine motor skills before and after participation in natural material-based collage activities. The pretest was administered to establish baseline fine motor performance, followed by the collage intervention and a posttest to assess changes in performance.

The participants were 15 Group B children aged 5-6 years at RA Al-Ikhlas Birobuli Selatan, Palu City, comprising 11 girls and 4 boys enrolled during the second semester of the 2025/2026 academic year.

Data were collected through structured observation, interviews, and documentation. The primary instrument was an observation sheet using a rating scale to assess three dimensions of fine motor skills: (1) hand-eye coordination when attaching collage materials, (2) manipulative movements when handling and arranging materials, and (3) finger flexibility during collage activities. Interviews and documentation provided supplementary information to contextualize the observational findings.

Data were analyzed using SPSS through descriptive and inferential statistical procedures. Descriptive statistics were used to summarize children's fine motor performance before and after the intervention. The normality of the pretest-posttest difference scores was assessed before conducting a paired-samples t-test to determine whether the mean scores differed significantly. Statistical significance was established at $\alpha = .05$. A p-value below .05 was considered evidence of a statistically significant difference between pretest and posttest scores.

4) Results and Discussion

a) Results

This research process was conducted during April 2026, to determine the extent of the dynamics of children's fine motor skills. In accordance with the formulation of the problem, objectives, and benefits of this study, the researcher focused on the implementation of natural material collage activities, as well as improving the fine motor skills of group B children at RA Al Ikhlas Birobuli Selatan, Palu Selatan District, Palu City.

Observation Results Before Treatment

Prior to the treatment, the researchers observed the children's classroom activities, such as free-drawing and coloring animal patterns provided by the teacher. The results of observations of 15 children participating in these activities are shown in the table below:

Table 1. Children's Fine Motor Skills Before Treatment

Category	Aspects Eye and Hand Coordination		Aspects Manipulative Movement		Aspects the Flexibility of the Fingers		Average (%)
	F	%	F	%	F	%	
Very Well Developed (BSB)	0	0	0	0	0	0	0
Developing as Expected (BSH)	3	20	1	6.67	1	6.67	11.11
Starting to Develop (MB)	7	46.67	7	46.67	6	40	44.45

Category	Aspects Eye and Hand Coordination		Aspects Manipulative Movement		Aspects the Flexibility of the Fingers		Average (%)
	F	%	F	%	F	%	
Not Yet Developed (BB)	5	33.33	7	46.67	8	53.34	44.45
Total	15	100	15	100	15	100	100

According to table 1, observation of children's fine motor skills before being given treatment, of the 15 children who were the subjects of the study, in all aspects, there were no children (0%) in the BSB category. The first aspect is eye and hand coordination, there were 3 children (20%) in the BSH category, there were 7 children (46.67%) in the MB category, and there were 5 children (33.33%) in the BB category. The second aspect is manipulative movements, there was 1 child (6.67%) in the BSH category, there were 7 children (46.67%) in the MB category, and there were 7 children (46.67%) in the BB category. The third aspect is finger flexibility, there was 1 child (6.67%) in the BSH category, there were 6 children (40%) in the MB category, and there were 8 children (53.34%) in the BB category. These data are further presented in the form of a bar chart in the figure below.

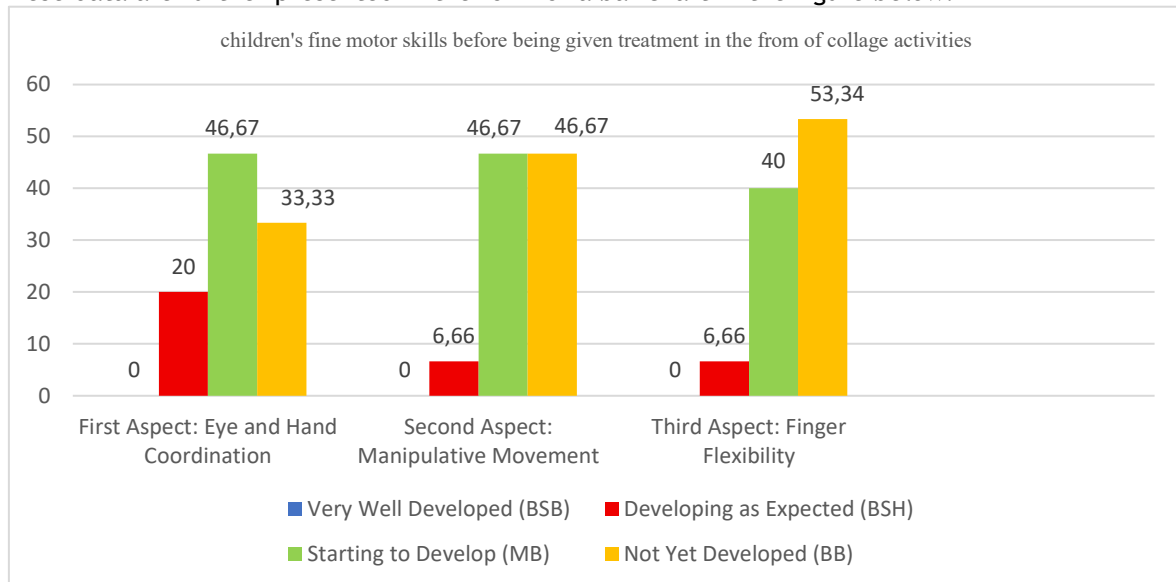


Figure 1. Histogram of Observation Data Before Treatment

According to Figure 1, observation of children's fine motor skills before being given treatment, the most prominent bar charts can be seen in the green bar chart, namely the Beginning to Develop (MB) category in the eye-hand coordination aspect and the purple bar chart for the Not Yet Developed (BB) category in the finger flexibility aspect. The second aspect of manipulative movements has two green bar charts, the MB category and the purple bar chart, the BB category. The lowest bar chart is in all aspects with the Very Well Developed (BSB) category.

The activity provided during the research process was a collage activity using natural materials prepared by the researcher. The preparation process for the collage activity utilized various natural materials found around the home. The natural materials provided included corn kernels, mung bean seeds, eggshells, and dried leaves. The tools or materials provided included glue, which was used to attach the paper patterns, including patterns of mangoes, corn, sunflowers, and eggs.

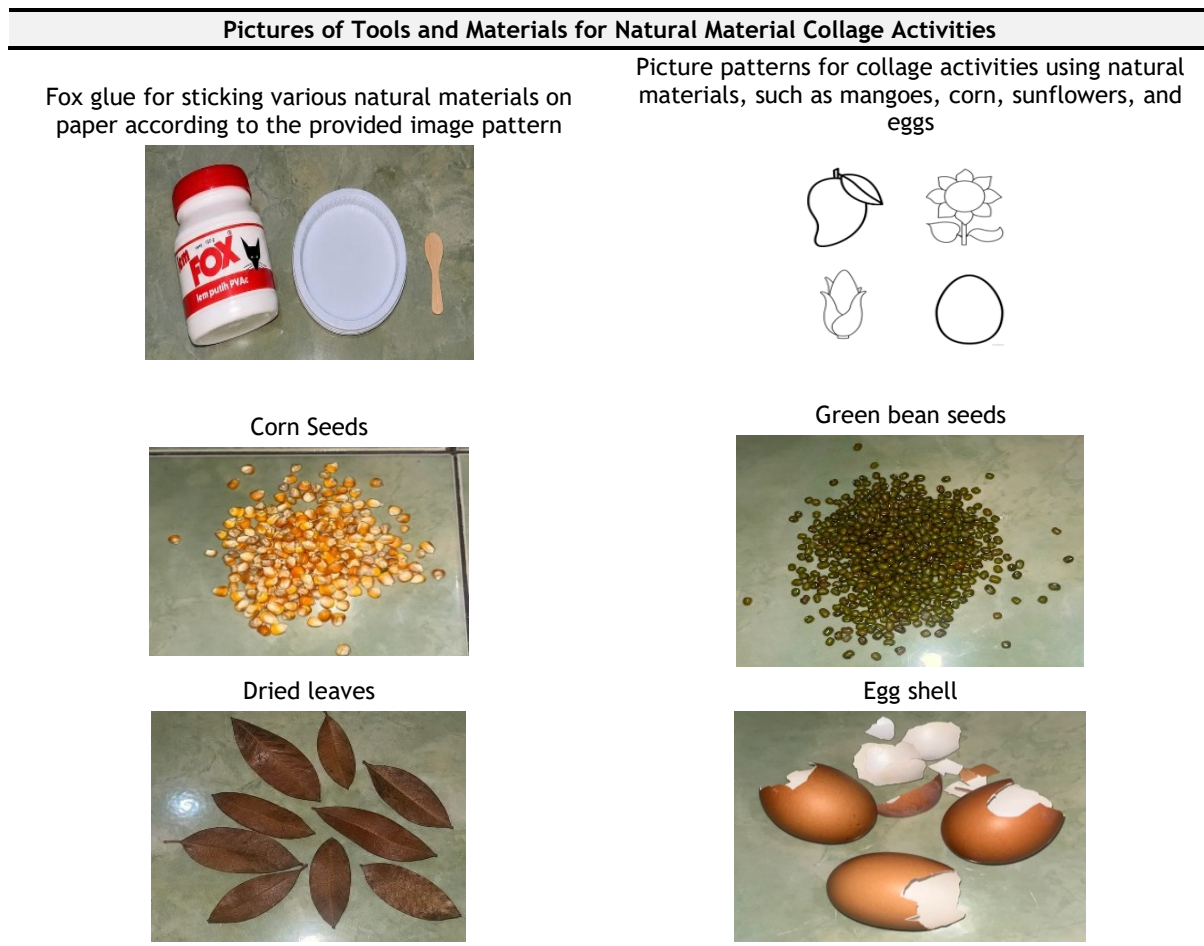


Figure 2. Tools and Materials for Natural Material Collage

The following table shows the results of observations during the research process. These observations were conducted a week after observing the children's activities before the collage activity was administered. The researchers prepared all the necessary materials to ensure the smooth and effective observation of the children's fine motor skills. The following are the results of the observations after the natural material collage activity was administered, as outlined in Table 2 below:

Table 2. Children's Fine Motor Skills After Treatment

Category	Aspects Eye and Hand Coordination		Aspects Manipulative Movement		Aspects the Flexibility of the Fingers		Average (%)
	F	%	F	%	F	%	
Very Well Developed (BSB)	9	60.00	6	40.00	5	33.33	44.44
Developing as Expected (BSH)	6	40.00	8	53.34	8	53.34	48.89
Starting to Develop (MB)	0	0	1	6.67	2	13.33	6.67
Not Yet Developed (BB)	0	0	0	0	0	0	0
Total	15	100	15	100	15	100	100

According to table 2, observations of children's fine motor skills after being given treatment, from 15 children who were the subjects of the study, the first aspect is eye and hand coordination, there are 9 children (60.00%) in the BSB category, there are 6 children (40.00%) in the BSH category, there are no children in the MB and BB categories. The second aspect is manipulative movements, there are 6 children (40.00%) in the BSB category, there are 8 children (53.34%) in the BSH category, there is 1 child (6.67%) in the MB category, and there are no children in the BB category. The last aspect is finger flexibility, there are 5 children (33.33%) in the BSB category, there are 8 children (53.34%) in the BSH category, there are 2 children (13.33%) in the MB category, and there are no children in the BB category. This data is then presented in the form of a bar graph in the image below.

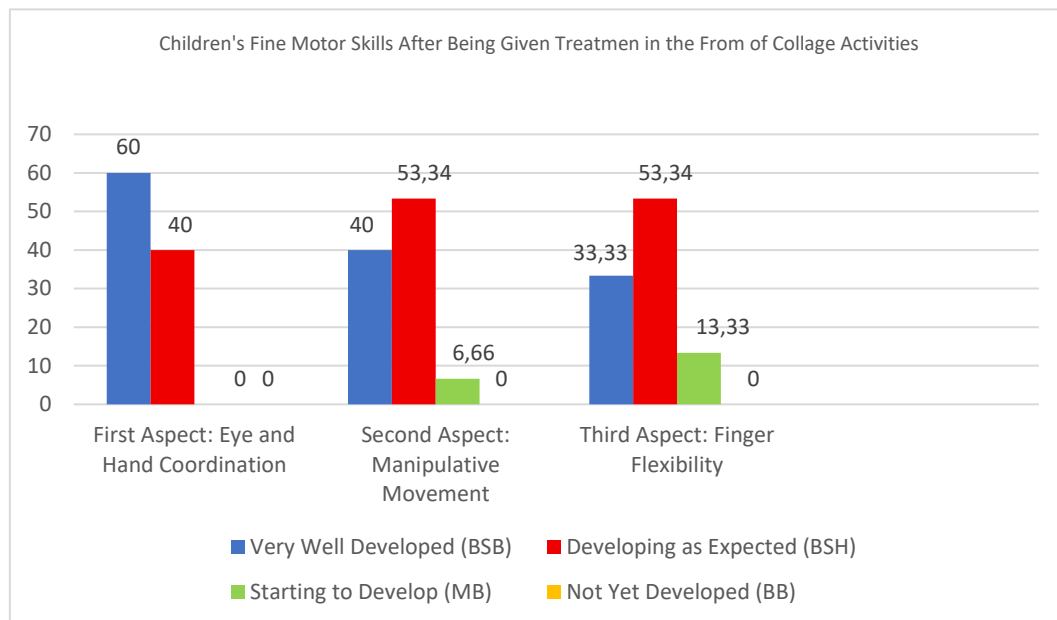


Figure 3. Histogram of Observation Data After Treatment

According to Figure 3, observations of children's fine motor skills after being given treatment, the most prominent bar graph can be seen in the blue bar graph, namely the Very Well Developed (BSB) category in the eye-hand coordination aspect. The next prominent graph in the red bar is for the Developing According to Expectations (BSH) category in the manipulative movement and finger flexibility aspects. The lowest bar graph in all aspects is marked by the purple bar graph, which is the Not Yet Developed (BB) category.

Furthermore, inferential analysis was conducted to test the effectiveness of the natural material collage activity in Group B of RA Al Ikhlas Birobuli Selatan, South Palu District. Before testing the hypothesis using a paired sample t-test, a prerequisite test, namely a normality test, was first conducted to determine whether the data met the assumption of a normal distribution. After the data were confirmed to be normally distributed, the analysis continued with paired sample statistics, paired sample correlations, and a paired sample t-test to determine the difference in children's fine motor skill scores before (pretest) and after (posttest) the treatment.

Table 3. Test of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	.167	15	.200*	.915	15	.159
Posttest	.139	15	.200*	.920	15	.192

*. This is a lower bound of the true significance.

According to Table 3, the Shapiro-Wilk normality test shows a pretest statistic of 0.915 with a significance value of 0.159, and a posttest statistic of 0.920 with a significance value of 0.192. Both significance values are greater than 0.05, so it can be concluded that the pretest and posttest data are normally distributed. Thus, the data meet the assumptions for hypothesis testing using the paired sample t-test.

Table 4. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Posttest	10.1333	15	1.35576	.35006
	Pretest	5.0000	15	1.64751	.42538

According to table 4, it shows that the average score achieved by children before being given treatment was 5.0000, while after being given treatment the average score achieved was 10.1333.

Table 5. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Posttest & Pretest	15	.352	.199

Table 5 shows that the correlation between the two variables is 0.352 with a significance level of 0.199. This indicates a weak and statistically non-significant relationship ($p > 0.05$) between the pretest and posttest scores. A significant correlation is not a requirement for the paired sample t-test, so the test of the mean difference in Table 6 remains the basis for the decision.

Table 6. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Posttest - Pretest	5.13333	1.72654	.44579	4.17721	6.08946	11.515	14	.000

According to Table 6, the calculated t value is 11.515 with a significance of 0.000 (< 0.05), so H_0 is rejected and H_1 is accepted. This shows that natural material collage activities have a significant effect on the fine motor skills of Group B children at RA Al-Ikhlas Birobuli Selatan.

b) Discussion

The findings indicate that natural material-based collage activities are associated with improvements in children's fine motor skills, particularly hand-eye coordination, manipulative movements, and finger flexibility. Activities involving grasping, arranging, and attaching natural materials provide opportunities to practice controlled hand and finger movements. The different sizes, shapes, and textures of the materials also require children to adjust their movements according to task demands. These findings are consistent with previous studies highlighting the potential of collage activities to support fine motor development in early childhood ([Sidabutar & Siahaan, 2019](#); [Akollo et al., 2023](#); [Sholikhah, 2023](#)).

Hand-Eye Coordination

The posttest results showed that nine children (60%) achieved the Very Well Developed (BSB) category, while six children (40%) reached the Developing as Expected (BSH) category. These results indicate that all participants attained at least the expected developmental level in hand-eye coordination following the intervention. Children demonstrated this ability by selecting natural materials, directing their hand movements toward designated patterns, and attaching materials with increasing precision.

The use of corn kernels, mung beans, eggshell fragments, and dried leaves required children to coordinate visual information with controlled hand movements. Differences in material size and texture created opportunities to adjust grasping techniques, placement accuracy, and finger pressure. This finding aligns with [Akollo et al. \(2023\)](#), who reported improvements in fine motor performance through natural material collage activities. Similarly, [Wijaya et al. \(2024\)](#) identified hand-eye coordination as an important component of fine motor development during collage activities. These findings suggest that manipulating and positioning natural materials can provide practical stimulation for visual-motor coordination.

Manipulative Movements

The posttest assessment showed that 53.3% of the children reached the Developing as Expected (BSH) category in manipulative movements. This finding indicates that most participants demonstrated age-appropriate abilities in handling and positioning collage materials, although further practice may be needed to achieve higher developmental levels.

Manipulative movements were demonstrated through grasping, pinching, transferring, arranging, and pressing materials onto designated patterns. These activities required children to regulate grip strength, finger pressure, and movement precision. Smaller materials, particularly grains, encouraged the use of the pincer grasp, while larger or irregularly shaped materials required

adjustments in finger positioning. Previous studies have similarly reported that collage and other object-manipulation activities support the development of fine motor control ([Sidabutar & Siahaan, 2019](#); [Monoarfa et al., 2025](#); [Ernawati et al., 2025](#)). Thus, natural material collage provides opportunities for repeated object manipulation, which is relevant to children's emerging writing, cutting, and other practical motor skills.

Finger Flexibility

The posttest results also indicated that 53.3% of the children achieved the Developing as Expected (BSH) category in finger flexibility. This result suggests that most participants demonstrated adequate finger movement control during collage activities, although not all had reached the highest developmental category.

Finger flexibility was observed when children opened and closed their fingers, adjusted their grip, repositioned small objects, and applied controlled pressure while attaching materials. The variation in natural materials required different finger movements and levels of precision, providing opportunities to practice movement flexibility and coordination. These observations are consistent with [Wijaya et al. \(2024\)](#), who emphasized finger flexibility in fine motor activities involving collage. Similar findings were reported by [Sulistiowati et al. \(2023\)](#) and [Fauziddin et al. \(2023\)](#), who highlighted the contribution of structured finger-movement activities to fine motor development. Accordingly, natural material collage may serve as an accessible learning activity for practicing finger flexibility through repeated and purposeful movements.

The paired-samples t-test revealed a statistically significant difference between pretest and posttest fine motor scores, $t(14) = 11.515$, $p < .001$. This result indicates measurable changes in children's fine motor performance following participation in natural material-based collage activities. However, the descriptive findings also show differences across developmental dimensions, with hand-eye coordination reaching a higher category than manipulative movements and finger flexibility.

These findings suggest that teachers can integrate natural material collage into early childhood learning activities to provide structured fine motor practice. Activities can be organized progressively, beginning with larger materials and advancing to smaller objects requiring greater finger control and precision. Nevertheless, the small sample size and absence of a control group limit causal interpretation and the generalizability of the findings. Further research using controlled experimental designs and larger samples is needed to establish the effectiveness of this approach more conclusively.

5) Concluding Remarks and Recommendation

Based on the research results, it can be concluded that natural material collage activities have a positive and significant effect on the fine motor skills of Group B children at RA Al-Ikhlas, Birobuli Selatan, South Palu District, Palu City. After the treatment, 60.00% of children were in the Very Well Developed (BSB) category for eye-hand coordination, while manipulative movements and finger flexibility were each in the Developing as Expected (BSH) category at 53.34%. The paired sample t-test showed $t(14) = 11.515$ with a significance level of 0.000 ($p < 0.05$), so H_0 was rejected and H_1 was accepted.

These findings indicate that natural material collage, using materials that are easily found in the surrounding environment, can be used by early childhood teachers as an enjoyable and contextual activity for stimulating fine motor skills. Teachers can design collage activities gradually, from larger to smaller materials, so that the demands on finger flexibility and control increase in line with children's developing abilities.

This study used a one-group pretest-posttest design without a control group, involved 15 children in a single institution, and was conducted over a short period in April 2026, so the results cannot be generalized widely. Future research is recommended to use a control group, a larger sample from several institutions, and a longer treatment period.

Statement of Use of Generative AI

During the preparation of this work, the author used ChatGPT to assist in improving clarity and readability of the text. The author reviewed and edited the output and takes full responsibility for the content of the publication.

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