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Enhancing Creativity in 4-5-Year-Olds: A Quasi-Experimental Study of Nature-Based Leaf-Stamp Batik

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Abstrak:
Penelitian ini mengkaji efektivitas kegiatan membatik cap dari bahan alam (daun) sebagai strategi untuk menstimulasi kreativitas anak usia 4-5 tahun (Kelompok A). Masalah utama yang melatarbelakangi studi ini adalah masih dominannya pembelajaran seni konvensional yang berpusat pada guru, sehingga menghambat perkembangan orisinalitas dan fleksibilitas berpikir anak. Metode penelitian yang digunakan adalah kuantitatif dengan desain kuasi eksperimen tipe One-Group Pretest-Posttest yang melibatkan 14 subjek. Kreativitas diukur menggunakan empat indikator Torrance: kelancaran, keluwesan, orisinalitas, dan pemerincian. Analisis data menggunakan uji-t berpasangan menunjukkan peningkatan kreativitas anak yang signifikan, dengan kenaikan skor rata-rata dari 5,00 pada saat pre-test menjadi 15,71 pada saat post-test ($t = -48{,}568$ $p < 0{,}001$). Hasil ini memberikan justifikasi empiris bahwa integrasi bahan alam di lingkungan sekitar sebagai media cetak tinggi merupakan strategi yang efektif dan berkelanjutan dalam membangun kepercayaan diri kreatif anak. Simpulan penelitian menegaskan bahwa modifikasi teknik membatik tradisional menjadi kegiatan membatik cap daun mampu menciptakan pengalaman belajar bermakna yang mengoptimalkan capaian perkembangan anak usia dini.

Kata Kunci: Kreativitas; Membatik Cap Daun; Bahan Alam; Anak Usia Dini

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Abstract

This research examines the effectiveness of leaf-based batik stamping activities as a strategy to stimulate the creativity of children aged 4-5 years (Group A). The study addresses the dominance of conventional, teacher-centered art learning that hinders the development of children's originality and flexible thinking. The research employed a quantitative approach with a One-Group Pretest-Posttest quasi-experimental design involving 14 subjects. Creativity was measured using Torrance's four indicators: fluency, flexibility, originality, and elaboration. Data analysis using a paired t-test revealed a significant increase in children's creativity, with the mean score rising from 5.00 in the pre-test to 15.71 in the post-test ($t = -48.568$ $p < 0.001$). The results empirically justify that integrating surrounding natural materials as a relief print medium is an effective and sustainable strategy for enhancing creative confidence. The study concludes that modifying traditional batik into leaf-stamping activities creates meaningful learning experiences that optimize developmental outcomes in early childhood.

Keywords: Creativity; Leaf Stamping Batik; Natural Materials; Early Childhood

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INTRODUCTION

Early Childhood Education (ECE) serves as a fundamental cornerstone of human development, particularly during the golden age, when children's neural plasticity enables them to absorb various external stimuli. At the age of 4–5 years (Group A), children are developing the cognitive, affective, and psychomotor readiness needed for the transition to primary education. One important developmental indicator at this stage is creativity, which forms part of the graduate profile within the foundation phase of the *Kurikulum Merdeka*. This framework emphasizes children's ability to express thoughts and feelings through diverse media rather than focusing solely on aesthetic products. Creativity development involves honing divergent thinking skills that enable children to explore solutions from different perspectives (Irna, 2024). However, creativity is often marginalized by literacy-and-numeracy-oriented learning (*calistung*) and rigid conventional methods (Nadhifah & Aisyah, 2025). Without adequate stimulation, children's imaginative potential may be limited, potentially affecting their future adaptability

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and problem-solving abilities. Therefore, arts education in ECE institutions needs to integrate freedom of expression with media that stimulate children's curiosity (Nurfaizah & Na'imah, 2021).

From the perspective of developmental psychology, creativity is a multidimensional construct involving original mental processes and the courage to move beyond conventional norms (Agustina & Nurhayati, 2021). Drawing upon Rhodes' (1961) 4P theory, creativity represents a synergy between Person, Process, Press, and Product ('Athiya & Fauzi, 2025). The process dimension is particularly important during early childhood, when children learn through experimentation, failure, and discovery. E. Paul Torrance's indicators of creative thinking, comprising fluency, flexibility, originality, and elaboration, serve as essential parameters for assessing creativity in artistic activities (Mulyadi, 2024). Nevertheless, teacher-centered practices that require children to color predefined patterns can limit originality and flexibility. Without opportunities for independent exploration and elaboration, artistic activities risk becoming routine exercises rather than meaningful experiences that stimulate creative thinking.

The utilization of natural materials in art education offers advantages over synthetic media because they are concrete, multisensory, and rich in texture (Aisyiah & Pamungkas, 2023). These characteristics are relevant to the pre-operational stage of cognitive development described by Jean Piaget (Iryouw et al., 2025). Leaves, which are readily available in children's surroundings, offer diverse morphological forms, including pinnate, palmate, and curved shapes, as well as prominent venation textures that can function as natural printing templates. Their use also supports children's visual development, as described in Viktor Lowenfeld's pre-schematic stage, while encouraging appreciation of ecosystems and naturalist intelligence (Yunita et al., 2024). Through leaf exploration, children can learn about color and shape composition while engaging in tactile experiences that support fine motor development (Fitrianingsih et al., 2018). Thus, integrating natural materials into ECE arts education can create meaningful learning experiences that are economical and sustainable (Safura et al., 2024).

Batik-making, as an intangible cultural heritage, has technical complexity but can be adapted for early childhood through modified stamping techniques (Adhe et al., 2023). Batik stamping (*batik cap*) is a relief-printing technique that transfers motifs from a template onto fabric or paper. For children aged 4–5 years, this technique offers an engaging experience through visible printed results while

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requiring precision in pressing and coloring. By using leaves instead of a *canting* and hazardous hot wax, the activity provides a safer opportunity for children to experiment. Children can explore cause-and-effect relationships, such as how leaf veins produce different prints and how color combinations create new colors. The activity also develops fine motor control and hand-eye coordination through the application of appropriate pressure to transfer leaf motifs onto the medium (Putri & Maulana, 2025).

Previous studies have explored various nature-based art techniques, including *jumputan* (tie-dye), banana frond stamping, and *ecoprint* through pounding. Although these techniques can support children's creativity, each has limitations. *Jumputan* tends to emphasize gross motor skills through fabric wringing rather than visual detail, while banana fronds often produce repetitive circular or oval motifs. Similarly, pounding techniques in *ecoprint* can damage leaf structures, limiting opportunities for flexible compositional arrangements. These limitations indicate a need for further empirical investigation into the use of leaves with diverse morphological structures and venation textures to stimulate creative decision-making and all four of Torrance's creativity indicators. In contrast to previous approaches, the present study focuses on natural relief printing using diverse leaves, allowing children to explore motif arrangements and develop flexibility and elaboration through their compositions (Rahmawati, 2025).

The urgency of this research is also related to concerns about declining creativity associated with excessive gadget exposure among young children in the post-pandemic period, where children may become passive consumers of content rather than active producers of ideas. Leaf-stamping batik provides an opportunity to re-engage children in physical activities involving direct sensorimotor experiences (Hida et al., 2022). Through interaction with natural materials, children can develop focus and patience while expressing their emotions and personal identities through individual color choices. Documenting the use of leaf-stamping batik is therefore important as a reference for ECE practitioners in designing activities that support children's creative development and multiple intelligences (Nururrohmah et al., 2025).

Theoretically, this research also highlights that limited infrastructure and facilities in ECE institutions need not hinder creativity development, as leaves are readily available and can serve as affordable learning materials. This perspective broadens the understanding of educational teaching aids (*Alat Permainan Edukatif* or

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APE) as materials in children's surroundings that can stimulate cognitive processes (Rakhmawati, 2022). In the context of leaf-stamping batik, the *Press* aspect of Rhodes' 4P theory is reflected in the environmental stimulus provided by natural materials and children's involvement in collecting and selecting leaves. Such involvement can foster a sense of ownership and intrinsic motivation, which, according to Amabile's theory, is essential to creative productivity. The novelty of this research lies in the use of diverse leaf forms and venation textures as natural printing media to provide children with opportunities for creative decision-making through the integration of local cultural heritage and nature exploration.

This study aims to analyze the effectiveness of nature-based leaf-stamp batik in stimulating creativity among children aged 4–5 years. It focuses on changes in creativity scores across the four indicators of fluency, flexibility, originality, and elaboration, as well as children's behavioral dynamics during the activity. Rather than focusing solely on the final artwork, the study considers how children respond to challenges, arrange leaf motifs, and make decisions about color compositions. The findings are expected to contribute to early childhood art education by providing empirical evidence on the use of local and sustainable materials to support creativity development within the foundation phase of the *Kurikulum Merdeka*.

METHOD

This study employed a quantitative approach with a pre-experimental one-group pretest-posttest design. This design was selected to measure the changes in creativity levels within a single group before and after the introduction of the leaf-stamping batik intervention. The research was conducted at TK Adhyaksa III Surabaya with a total sampling technique involving 14 children aged 4–5 years (Group A).

Instrumental Framework and Operationalization

The research instrument was adapted from the Torrance Tests of Creative Thinking (TTCT), specifically operationalized into four behavioral indicators suitable for the early childhood context:

1. Fluency: The child's ability to produce a variety of leaf-stamping patterns within a set duration.
2. Flexibility: The variety of leaf types (pinnate, palmate, curved) and color

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combinations used in the composition.

3. Originality: The uniqueness of the stamping arrangement that deviates from the teacher's initial example.
4. Elaboration: The child's ability to add decorative details or fill the negative space around the stamps to complete the artwork.

Data Collection and Scoring

The assessment was conducted using a structured observation rubric with a 4-point Likert scale: 1 (Not Yet Developed), 2 (Starting to Develop), 3 (Developing According to Expectations), and 4 (Developing Very Well). To ensure instrument validity, the rubric underwent expert judgment by a senior practitioner in early childhood education. Reliability was maintained through inter-rater reliability, where the researcher and the mentor teacher (*Guru Pamong*) independently scored the children's work, followed by a consensus on any scoring discrepancies to minimize subjective bias.

Procedures and Analysis

The research procedure followed three stages: (1) Pre-test, to assess initial creativity through a conventional coloring task; (2) Treatment, consisting of four sessions of nature-based leaf-stamping batik; and (3) Post-test, to evaluate the final creativity scores. Data were analyzed using a paired sample t-test via SPSS to determine the significance of the mean difference between the pre-test and post-test results.

RESULTS AND DISCUSSION

RESULTS

This study aims to determine the effectiveness of the leaf-stamping batik intervention on creativity variables by comparing pretest and posttest scores within a single subject group. Based on the descriptive statistical analysis, the data overview is presented in Table 1.:

Table 1: Summary of Descriptive Statistics (Paired Samples Statistics)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pretest	5.0000	14	.78446	.20966
	posttest	15.7143	14	.46881	.12529

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Figure 1. Implementation of leaf-stamping batik activities

Based on Table 1, there is a measurable difference in the mean scores. The pretest mean score of 5.00 represents the subjects' baseline ability level prior to the intervention. Following the treatment, the posttest mean score rose to 15.71, indicating an absolute increase of 10.71. Furthermore, the Standard Deviation for the posttest (0.468) is lower than that of the pretest (0.784), suggesting that following the treatment, the distribution of student scores became more homogeneous.

The next stage involved examining the correlation between the pretest and posttest scores to determine the consistency of subject performance.

Table 2: Paired Samples Correlations Results

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	pretest & posttest	14	.209	.473

The correlation test results show a coefficient of 0.209 with a significance value (Sig.) of 0.473. Since $p > 0.05$, there is no statistically significant correlation between the pretest and posttest scores. This suggests that the improvement observed was relatively independent of the subjects' initial abilities, indicating that the intervention was beneficial across different baseline levels within the group.

Table 3: Paired Samples T-Test Results

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	pretest - posttest	-10.71429	.82542	.22060	-11.19087	-10.23770	-48.568	13	.000

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Which is below the significance threshold of $p < 0.05$ therefore, the Null Hypothesis (H_0) is rejected. The t-value of -48.568 reinforces these findings, where the negative sign indicates that the posttest scores were consistently higher than the pretest scores. To determine the magnitude of this effect, Cohen's *d* was calculated as follows:

$$d = \frac{Mean\ difference}{Standart\ Deviation\ Difference} = \frac{10.714}{0.825} \approx 12.98$$

An effect size of 12.98 is categorized as large (Cohen, 1988), providing empirical evidence that the intervention had a substantial impact on the participants' creativity scores.



Figure 2. Children's leaf-stamping batik artworks

The increase from 5.00 to 15.71 represents a notable improvement in the subjects' creative performance. In early childhood education contexts, such a trend suggests that the sensory-motor involvement in leaf-stamping batik is a viable method for stimulating creativity. The decrease in the Standard Deviation suggests that the intervention helped in narrowing the competency gap among the subjects.

The t-value of 48.568 significantly exceeds the t-table value for d = 13 (approximately 2.160), which indicates that the observed change is statistically significant and likely associated with the intervention. These results offer a basis for the argument that nature-based art activities can positively influence the development of creativity in children aged 4–5. This aligns with the view that sensory-motor engagement is a key factor in early childhood cognitive and creative development.

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Figure 3. Implementation of leaf-stamping batik activities

DISCUSSION

Dynamics of Torrance's Creativity Indicators

The significant increase in creativity scores—from a pretest mean of 5.00 to a posttest mean of 15.71—suggests that nature-based leaf-stamp batik is an effective pedagogical intervention. This improvement can be analyzed through the four dimensions of Torrance's creativity framework. Fluency was observed as children gained the confidence to produce multiple motifs, while flexibility emerged from the cognitive process of selecting various leaf morphologies (pinnate, palmate, etc.) to create diverse patterns. Originality and elaboration were manifested in the subjective color choices and the meticulous pressure applied to transfer intricate vein textures onto the medium.

This success is attributable to the fulfillment of the four indicators of creativity proposed by E. Paul Torrance within the context of the leaf-stamped batik (*batik cap daun*) activities. First, Fluency is evidenced by the children's ability to produce numerous motif imprints on a single worksheet; this abundance of ideas represents the initial stage of expressive courage. Second, Flexibility emerges as children select diverse leaf types such as palmate, pinnate, and curved to create varied patterns. The use of diverse leaf types encourages children to move beyond a single pattern (Haryanti, 2019).

Third, the aspect of Originality is reflected in the children's creative decisions regarding color combinations and motif layouting, which result in unique outputs distinct to each individual (Ismar & Sandra, 2024). The freedom to select natural media fosters the emergence of authentic works. Finally, Elaboration is evidenced when children meticulously press leaf veins or layer motifs to produce richer visual

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effects. The intricate details in children's artwork signify the engagement of higher-order brain executive functions (Pujhana et al., 2024).

These research findings reinforce the assertion that a one-group design is highly sensitive in monitoring individual subject development (Laksana & Wulandari, 2022). The Torrance instrument remains the most valid parameter for measuring children's imaginative bursts (Ulya Ainur Rofi'ah et al., 2023). A score increase exceeding 100% serves as a primary indicator of a successful arts curriculum. A significance level of 0.000 validates the pedagogical efficacy of the intervention (Qohar et al., 2026). The homogeneity of scores at the conclusion of the study reflects consistent instructional effectiveness across the teaching process.

The low correlation (0.209) serves as evidence that the intervention achieved a total transformation of the subjects, rather than a mere linear progression. The sample size of 14 subjects is ideal for in-depth ethnographic behavioral observation; furthermore, the implementation of a single-group control minimizes the bias of external variables within the Early Childhood Education (ECE) environment. The utilization of natural materials significantly enhances children's intrinsic motivation (Suryadi, 2025). The high t-value (-48.5) represents a remarkably robust effect size.

Furthermore, the score increase of over 200% demonstrates that leaf media can effectively mitigate post-pandemic creativity degradation. The implementation of relief printing techniques is utilized due to its capacity to foster complex hand-eye coordination. The exploration of leaf morphology fosters the development of children's naturalistic intelligence from an early age (Marwah, 2017). Children with the lowest baseline abilities often exhibit the most dramatic surges when interacting with natural materials (Herayati & Patilima, 2023). The importance of data reliability is evident from the small standard error (0.22).

The effectiveness of this intervention is rooted in the Constructivist learning theory, where children are not passive recipients but active constructors of knowledge through direct interaction with their environment. The use of leaves as a "natural cliché" provides a concrete sensory-motor experience that aligns with Piaget's pre-operational stage. Unlike synthetic media, the organic textures of leaves offer unpredictable results that challenge children to adapt their techniques, thereby stimulating divergent thinking. This process aligns with Mel Rhodes' 4P Theory, specifically the 'Press' (environmental stimulus) and 'Process' aspects; the availability of diverse natural materials (Press) encourages an exploratory creative process that ultimately leads to a unique 'Product' (Rhodes, 1961).

Creative decision-making in selecting leaf media is a tangible manifestation of

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self-directed learning. The novelty of this research lies in the utilization of pluralistic media to stimulate originality. Furthermore, the leaf-stamping batik technique challenges the paradigm that high-quality artistic media must be costly. A significance level of 0.000 serves as irrefutable empirical evidence of these findings. Collectively, these results demonstrate that the children have achieved the Creativity indicators within the Foundation Phase; they are now capable of independently communicating their thoughts and feelings through ideas and tangible works generated from the exploration of diverse media.

The narrowing gap between subjects indicates the success of equitable stimulation. These results serve as a validation of Mel Rhodes' 4P Theory (Person, Process, Press, Product) (Rhodes, 1961). Furthermore, the meticulous process of selecting the appropriate leaves cultivates children's focus and patience (Lubis, 2026). The satisfaction derived from seeing the final printed results significantly boosts children's learning motivation. Furthermore, the mean difference of -10.71 serves as tangible evidence of the transformation in their capabilities.

These activities successfully reconnect children with meaningful physical engagement. Observed upward trends suggest that this approach serves as an innovative solution to infrastructure and resource limitations. Furthermore, the research data exhibits high internal consistency. Leaf-stamping batik (*batik cap daun*) acts as a bridge between local wisdom and modern creativity (Safitri et al., 2024).

Compared to previous studies, these findings extend the discourse on early childhood art education. While studies on jumputan (tie-dye) emphasize gross motor skills, leaf-stamping requires a higher level of fine motor precision and spatial awareness (Adhe et al., 2023). Furthermore, while banana frond stamping often results in repetitive patterns, the morphological diversity of leaves encourages more complex compositional decision-making. The low correlation (0.209) between pretest and posttest scores in this study is particularly noteworthy; it suggests that the intervention provided a transformative learning experience that benefited all participants regardless of their initial ability levels, narrowing the competency gap within the group.

However, these findings must be interpreted with caution due to several methodological limitations. First, the use of a One-Group Pretest-Posttest design without a control group makes it difficult to completely isolate the intervention's effects from external factors, such as natural maturation or other classroom activities. Second, the small sample size (n=14) limits the generalizability of the results to a broader population. Despite these constraints, the high effect size (Cohen's $d \approx 12.98$)

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and the low standard error (0.22) indicate that within this specific context, the intervention had a robust and consistent impact.

In conclusion, leaf-stamping batik serves as a bridge between local wisdom and modern creative pedagogy. It offers a sustainable solution to resource limitations in ECE institutions while effectively reconnecting children with meaningful physical engagement. Future research should consider employing a randomized controlled trial (RCT) with a larger and more diverse demographic to further validate the longitudinal effects of nature-based interventions on creative development.

CONCLUSION

This study concludes that the leaf-stamping batik technique is effective in stimulating creativity among children aged 4–5 years, as indicated by the significant increase in pretest and posttest scores. The activity supported the development of four creativity indicators: fluency, flexibility, originality, and elaboration. Through the use of concrete and multisensory natural materials, children were encouraged to develop confidence in creative decision-making within an engaging learning environment. This research contributes empirical evidence to the integration of local and sustainable resources into early childhood education to support the Creativity dimension as part of the graduate profile in the foundation phase of the *Kurikulum Merdeka*.

However, this study has several limitations. The One-Group Pretest-Posttest design without a control group makes it difficult to exclude the influence of external factors or natural maturation on the results. Furthermore, the small sample size of 14 participants and relatively short intervention period limit the generalizability of the findings to larger or more diverse populations and do not provide evidence of long-term creative development.

Future research is therefore recommended to employ a True Experimental design with a control group and a larger sample size to improve external validity. Further studies could also explore a wider variety of natural materials and adopt a longitudinal approach to examine the sustained effects of art-based activities on children's creativity and academic development as they progress to higher educational levels.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the

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publication of this article.

AI DECLARATION

The authors declare that artificial intelligence (AI) tools were used solely to assist with language refinement and manuscript editing. All research data, analyses, interpretations, and conclusions were independently reviewed and verified by the authors, who take full responsibility for the accuracy and integrity of the entire manuscript.

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