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The Effectiveness of Plastic Recycling Montage in Stimulating Creativity of Children Aged 5–6 Years

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ABSTRACT

Background of the study: Creativity in early childhood has not developed optimally, as many learning activities still rely on worksheets. Developing creativity is crucial, as it fosters not only the ability to produce creative works but also critical thinking skills, enabling children to provide alternative solutions to problems in their daily lives.
Aims and scope of paper: This study aims to examine the effectiveness of plastic recycling montage activities in stimulating the creativity of children aged 5–6 years.
Methods: This study employed a quantitative approach with an experimental method using a pre-experimental one-group pretest–posttest design. The research was conducted at TK Bunda Burneh Bangkalan in Class B, involving 34 children aged 5–6 years. The study was carried out in three phases: preliminary study, implementation, and data processing, starting on November 18, 2023. Data were collected through observation, interviews, and documentation, supported by relevant literature from accredited journals, articles, and books. Data analysis involved prerequisite tests, including normality (Shapiro–Wilk) and homogeneity tests, followed by a t-test and N-Gain score analysis to determine the effectiveness of plastic montage recycling in stimulating children's creativity.
Results: The findings indicated a significant increase in children's creativity after participating in plastic recycling montage activities. The N-Gain Score result was 0.853, which falls into the "high" category, showing that the activity effectively stimulated creative abilities in early childhood.
Contribution: This study contributes to early childhood education by providing evidence that plastic recycling montage activities can serve as an innovative and effective approach to fostering creativity. Such activities not only enhance creative expression but also support the development of critical thinking and problem-solving skills in young children.

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INTRODUCTION

Plastic waste management has become a crucial environmental issue due to its non-biodegradable nature (Anwar et al., 2024; Hu et al., 2025; Joseph et al., 2025; Kapoor & Rafatullah, 2025; Kusmiyati & Fudholi, 2025; Maraveas & Hahladakis, 2025; Muñoz Yustres et al., 2025; Parsamanesh & Gümüş, 2025). Recycling is a strategic effort to reduce waste accumulation while providing added value by transforming discarded materials into more useful products (Grönlund et al., 2025; Martínez-Gomez-Aldaraví et al., 2025; Sulaimani et al., 2025; C.-Y. Zhang et al., 2026). Snack plastic waste, which is often considered useless, can actually be utilized as a learning medium for young children through plastic recycling montage activities (Abbas & Qureshi, 2025; Fujii et al., 2025; Kauppi et al., 2025; Le, 2025; Tripura et al., 2025; Wu et al., 2025). Such practices not only contribute to environmental sustainability but also hold great potential for stimulating children's developmental domains, particularly creativity (Chan & Liao, 2025; Jiju et al., 2025; Lightowlers et al., 2025; Ullah & Lin, 2025).

Creativity in early childhood is an essential component of cognitive development that enables children to generate ideas, produce works, and offer innovative solutions (Chen et al., 2024; Gu et al., 2025; Hasanah et al., 2025; Heaton, 2025; Li & Qi, 2025; Locander et al., 2025; Long et al., 2023; Rubenstein et al., 2018; Strouza et al., 2025; Su et al., 2025; J. Wang et al., 2025; Y. Wang, 2023; Wiśniewska & Karwowski, 2026; Y. Zhang & Zhang, 2025). According to Piaget's constructivist theory, children learn best through direct experiences with their environment, while Vygotsky emphasizes the importance of social interaction and the use of tools or media to support higher-order thinking (Gauvain, 2020; Matusov, 2015; Vygotskij & Cole, 1981). In this regard, the use of plastic waste in montage activities can serve as a meaningful learning medium because it combines exploration, imagination, and problem-solving.

However, preliminary observations conducted at TK Bunda Burneh Bangkalan on November 18, 2023, revealed that the creativity of children aged 5–6 years had not yet developed optimally. The learning process in the classroom was still largely dominated by the use of worksheets, which tended to emphasize repetitive tasks rather than stimulating higher-order thinking or creative expression. The utilization of environmental materials, particularly recycled items, as alternative learning media was also found to be very limited. Out of a total of 34 children in Class B, only 6 demonstrated progress that could be categorized as Emerging Development (ED), while the remaining 28 were still at the Not Yet Developed (NYD) level, indicating that their creative potential had not been adequately nurtured. In addition, interviews with teachers confirmed that the use of snack plastic waste in learning activities was minimal and mostly restricted to simple cutting or pasting tasks. Such practices, while providing basic motor skills, did not sufficiently engage children in more complex creative processes such as imagining, designing, or producing new forms. These findings underscore the urgent need to develop more innovative and environmentally oriented learning strategies, such as plastic recycling montage activities, to better stimulate creativity in early childhood education.

These findings highlight a significant research gap, namely the underutilization of alternative learning media based on recycled materials in early childhood education, particularly those aimed at enhancing creativity. While previous studies have emphasized the importance of creativity as a foundation for developing critical thinking, innovation, and problem-solving skills, research that specifically examines the effectiveness of plastic recycling montage in fostering creativity among young children remains limited, especially within the Indonesian context. The majority of existing literature tends to focus on conventional art activities, such as drawing, coloring, or origami, which, while valuable, may not fully address the need for sustainable and innovative learning practices. By integrating recycled materials into montage activities, children not only develop their creative and artistic skills but also cultivate environmental awareness and responsibility. Thus, further research is urgently needed to explore the pedagogical potential and long-term impacts of plastic recycling montage in early childhood education.

Thhis study is necessary to address this gap by investigating the effectiveness of plastic recycling montage activities in stimulating the creativity of children aged 5–6 years. The novelty

of this research lies in integrating environmental awareness (plastic waste management) with early childhood creativity development through montage activities. Thus, the study is expected to contribute both theoretically and practically, enriching early childhood education research and offering sustainable, environment-based learning strategies.

METHOD

Research Design

This study employed a quantitative approach with an experimental method, specifically using a pre-experimental design (Huang et al., 2025). The design applied was a one-group pretest–posttest design, in which participants were assessed before and after the intervention. The research was conducted at TK Bunda Burneh Bangkalan, beginning on November 18, 2023. The research process was carried out in three stages: (1) preliminary study, (2) implementation, and (3) data processing.

Participants

The participants consisted of 34 children from Class B at TK Bunda Burneh Bangkalan, including 15 boys and 19 girls, all aged between 5 and 6 years. The sample was determined through total sampling, as all children in the class were included in the study.

Data Collection

Data were obtained from two main sources: (1) relevant literature from accredited journals, articles, and books, and (2) field data collected directly from the research site (Grant et al., 2017). The techniques used included observation, interviews, and documentation. Observations were guided by an instrument containing four indicators of creativity development, each with three statements and corresponding assessment criteria. Interviews with teachers provided complementary qualitative insights, while documentation supported the validation of the findings.

Data Analysis

The data analysis involved prerequisite testing and statistical analysis (Bouanich et al., 2025). The prerequisite tests included a normality test (Shapiro–Wilk) and a homogeneity test. Following these, a paired-sample t-test was conducted to determine the significance of differences between the pretest and posttest scores. In addition, the N-Gain score was calculated to measure the effectiveness level of plastic recycling montage activities in stimulating children's creativity.

RESULTS

The instrument validity test obtained a result of 91%, which is categorized as very valid, indicating that the instrument was appropriate for use in this study. Furthermore, the reliability test conducted at TK Annahusada using the Cronbach's Alpha method yielded a score of 0.82, categorized as very high. The research was carried out at TK Bunda Burneh Bangkalan with a sample of 34 children in Group B, aged 5–6 years. This kindergarten is located in a densely populated residential area in Tunjung Village, Burneh District, Bangkalan Regency, and applies a thematic learning system arranged in annual, semester, weekly, and daily programs based on the national curriculum. The developmental aspects addressed include religious and moral values, gross and fine motor skills, cognitive development, language, socio-emotional growth, and artistic expression.

The research was conducted in three stages: pretest, treatment, and posttest. The pretest stage was carried out on June 10–11, 2024, through initial observations to measure children's creativity. On the first day, activities included listening to stories from a character values book, describing pictures, telling imaginative stories based on the theme, and creating a star drawing on HVS paper by pasting colored coconut fiber. On the second day, the children drew faces on HVS paper and attached origami paper on the head area to represent hair. The treatment stage was conducted on June 12–15, 2024, over four sessions. In the first session, the children were

introduced to the concept of plastic waste, its environmental impact, and which types can or cannot be reused, followed by collecting used snack packaging. The second session focused on sorting waste into categories (reusable/non-reusable, dry/wet, and hazardous/environmentally friendly), after which the children selected materials suitable for montage. In the third session, they washed and dried the selected plastic waste. Finally, in the fourth session, the children created two-dimensional montage artworks using the recycled plastic waste, guided by the researcher, who explained the meaning of montage, the tools and materials required, the steps involved, and the benefits of the activity. The posttest stage was implemented on June 18–19, 2024, where the children were asked to make a sailing ship from origami paper and a hot air balloon from plastic balloons and used bottles. At this stage, the evaluation focused on the children's creativity, particularly their skills in cutting, arranging, and pasting.

The pretest results showed that, out of 34 children, 4 children (11.8%) were in the Not Yet Developed (NYD) category, while 30 children (88.2%) were in the Beginning to Develop (BD) category. After the treatment, the posttest results demonstrated significant improvement, with 8 children (23.5%) categorized as Developing as Expected (DE) and 26 children (76.5%) categorized as Very Well Developed (VWD). These findings indicate that the plastic montage activity was effective in stimulating the creativity of early childhood learners at TK Bunda Burneh Bangkalan.

Table 1. Creativity Ability of Group B

No	Name	Pretest	Posttest	Score Increase
1	ANR	2.25	3.50	1.25
2	ASF	2.00	3.41	1.41
3	ARR	2.00	3.58	1.58
4	APR	2.00	3.25	1.25
5	AHI	2.41	3.91	1.50
6	AND	2.00	3.75	1.75
7	AHF	1.83	3.91	2.08
8	ABY	1.83	3.25	1.42
9	BFM	1.58	3.83	2.25
10	DM	1.83	3.41	1.58
11	FZ	2.08	3.58	1.50
12	FQA	2.08	3.66	1.58
13	KAD	1.91	3.66	1.75
14	KNA	2.16	3.75	1.59
15	KAD	1.66	3.66	2.00
16	MDA	2.00	3.66	1.66
17	MP	2.08	3.50	1.42
18	MAP	1.91	3.41	1.50
19	MAK	1.58	3.91	2.33
20	MAS	2.00	3.58	1.58
21	MAE	2.08	3.58	1.50
22	MIA	1.91	3.58	1.67
23	MZR	2.16	3.41	1.25
24	NAA	1.91	3.75	1.84
25	NAA	2.25	3.66	1.41
26	NS	2.16	3.66	1.50
27	RFT	2.00	3.75	1.75
28	RA	1.75	3.58	1.83
29	SKN	2.08	3.75	1.67
30	SDN	2.50	3.58	1.08
31	SKA	2.25	3.75	1.50
32	SIY	2.41	3.83	1.42
33	WN	2.25	3.58	1.33
34	WSU	2.33	3.83	1.50

Based on Table 1, it can be seen that the results of observations before treatment (pretest) and after treatment (posttest) show an improvement in each child at TK Bunda. The increase occurred after the treatment through Plastic Recycling Montage activities.

Table 2. Recapitulation of Pretest and Posttest Results

Number of Children	Pretest	Posttest	Score Increase
34	24.47	43.73	19.26

The pretest and posttest results in percentage form are presented as follows:

Data Analysis Prerequisite Test

The prerequisite test of data analysis aims to determine whether the data are normally distributed or not. The researcher calculated the data using a one-group pretest–posttest design with a total sample of 34 children. The data analysis technique employed was the paired sample t-test, as presented in the following table 3.

Table 3. Paired Sample t-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 – Postest	-19.265	3.287	.564	-20.412	-18.118	-34.171	33	.000

Based on the *t-test* results presented in Table 3, the significance value obtained was 0.000 (< 0.005). Accordingly, following the decision-making criteria, the null hypothesis (H_0) was rejected and the alternative/research hypothesis (H_a) was accepted. This indicates that there is a significant difference between the pretest and posttest results. Therefore, it can be concluded that the use of Plastic Recycling Montage activities had a significant effect on improving the creativity skills of children aged 5–6 years in Group B at TK Bunda.

Normality Test

Table 4. Normality Test Using Kolmogorov-Smirnov and Shapiro-Wilk

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Pretest	.107	34	.200*	.976	34	.638
Posttest	.144	34	.070	.958	34	.220

The normality test was conducted using the **Shapiro-Wilk method**. The decision rule states that:

- If the significance value > 0.05, the data are normally distributed.
- If the significance value < 0.05, the data are not normally distributed.

For the pretest, the significance value was 0.638 > 0.05, indicating that the data were normally distributed. For the posttest, the significance value was 0.220 > 0.05, which also indicates a normal distribution. Thus, both the pretest and posttest data were normally distributed.

Homogeneity Test

The homogeneity of variance for children's creativity skills was tested using SPSS 23 software. The decision rule is as follows:

- If the significance value > 0.05, the data variance is homogeneous.
- If the significance value < 0.05, the data variance is not homogeneous.

Table 5. Homogeneity Test

Levene Statistic	df1	df2	Sig.
2.750	1	66	.102

As shown in Table 5, the significance value was 0.102 > 0.05, which means that the variance of creativity skills among children aged 5–6 years using plastic recycling was homogeneous.

Hypothesis Testing

Hypothesis testing was conducted to determine the effectiveness of the Plastic Recycling Montage activity on children's creativity skills. The analysis compared the pretest and posttest results using SPSS 23 software.

Table 6. Hypothesis Testing (N-Gain Score)

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain	34	.65	1.00	.8538	.08526
Valid N (listwise)	34				

Based on the results of the N-Gain Score calculation, a score of 0.853 was obtained from the difference between the pretest and posttest results. This indicates that the effectiveness of the Plastic Recycling Montage activity in enhancing the creativity skills of children aged 5–6 years at TK Bunda reached 85%, which falls into the high category.

DISCUSSION

Based on the results of the *t-test*, the significance value obtained was 0.000 (< 0.005). According to the decision-making criteria, the null hypothesis (H_0) was rejected and the alternative/research hypothesis (H_a) was accepted. This finding indicates that there was a significant difference between the pretest and posttest results. Furthermore, the N-Gain analysis yielded a score of 0.853, which falls into the "high" category. This result demonstrates the effectiveness of the Plastic Recycling Montage activity in stimulating the creativity of children aged 5–6 years at TK Bunda.

This conclusion is consistent with the theory proposed who emphasized that montage activities allow children to develop their artistic abilities through cutting, pasting, arranging, and attaching images into unique and attractive compositions using recycled materials (Freund et al., 2024; Gururangan et al., 2018; Krauss & Lesser, 2018; Marcos-Martínez et al., 2025). The present study confirmed that children's creativity improved as they were able to complete montage activities involving cutting, pasting, and arranging colorful images neatly according to the chosen theme.

The assessment results also support this conclusion. Before the intervention, the pretest yielded a total score of 19, while the posttest increased significantly, reaching the highest total score of 47. The outcomes of this study reinforce the view that montage activities can improve children's artistic creativity, as the arrangement and composition of images in montage are designed to be engaging and enjoyable. Combining various images and colors produces artwork that is both aesthetically pleasing and meaningful (Apollonio et al., 2017; Guo et al., 2026; Ye & Wang, 2025).

The posttest results further revealed that the reuse of recycled materials in montage art—such as arranging existing elements or creating new compositions by cutting and reassembling prepared materials—enabled children to explore creative techniques. For instance, children were guided to cut materials according to a theme and paste them neatly on a prepared surface. This finding aligns with previous research, which emphasized that recycled plastic waste—such as disposable spoons, candy wrappers, raffia strings, and food packaging—can be transformed into valuable and aesthetically appealing creations (Pinto et al., 2025; Sahani et al., 2025; Sulistyorini et al., 2025).

Prior to the implementation of the Plastic Recycling Montage activity, many children tended to rely on more limited media, such as origami paper or worksheets, which often led to boredom and restricted their creative development. The introduction of varied and engaging activities was therefore necessary to stimulate children's creativity more optimally, fostering their exploratory nature and curiosity in artistic expression.

Several data collection techniques were employed in this study, including observation, questionnaires, and documentation. Observations conducted by teachers revealed that the montage activities had a notable impact on enhancing children's creativity. Overall, the findings indicate that Plastic Recycling Montage is an effective medium for promoting creativity among early childhood learners, as it not only engages them in enjoyable artistic practices but also cultivates environmental awareness through the creative reuse of waste materials.

Implications

The findings have practical implications for early childhood education. Teachers are encouraged to incorporate creative recycling-based art activities into their instructional practices as a means of fostering creativity and problem-solving skills in young children. Moreover, such activities can serve as an entry point for environmental education, raising children's awareness of sustainability issues while simultaneously developing their artistic abilities.

Research Contribution

This study contributes to the growing body of research on early childhood education by demonstrating the effectiveness of plastic recycling montage as a pedagogical strategy for stimulating creativity. It provides empirical evidence that integrating art-based recycling activities in early childhood classrooms not only enhances children's artistic skills but also promotes environmental awareness from an early age.

Limitations

Several limitations should be acknowledged. First, the study was conducted with a relatively small sample size limited to a single kindergarten, which may restrict the generalizability of the findings. Second, the study focused primarily on short-term outcomes without examining the long-term sustainability of creativity development. Lastly, the reliance on teacher observation as one of the primary data collection methods may introduce subjectivity.

Suggestions

Future studies should involve larger and more diverse samples across multiple schools to improve the generalizability of results. Longitudinal research is also recommended to investigate the long-term effects of montage recycling activities on creativity and other developmental domains such as social-emotional and cognitive skills. In addition, future research could explore the role of parental involvement in supporting creativity through recycling art projects conducted at home.

CONCLUSION

Based on the findings, it can be concluded that plastic recycling montage activities are effective in stimulating the creativity of children aged 5–6 years at TK Bunda. The research demonstrated significant improvements across several creativity indicators: fluency of thinking (22 children, 62%, categorized as very well developed), flexibility (33 children, 97%, very well developed), originality (21 children, 62%, very well developed), and elaboration (21 children, 62%, very well developed). Initially, most children were in the categories of not yet developed or starting to develop, whereas after the intervention, the majority shifted to developing as expected and very well developed. Specifically, 8 children achieved the developing as expected level, while 26 children reached the very well developed level. The overall effectiveness value was 85%, categorized as "high." These results were validated through the N-Gain Score test using SPSS 23 with 34 children in group B at TK Bunda.

Beyond the local context, these findings carry broader implications. Globally, early childhood education faces increasing challenges in balancing creativity development with environmental sustainability. The integration of recycling-based art activities provides not only an innovative strategy for fostering creativity but also a meaningful pathway for cultivating ecological awareness among young learners. This dual impact—on creativity and sustainability—underscores the potential of such interventions to contribute to global educational priorities, including the United Nations' Sustainable Development Goals (SDGs), particularly Goal 4 (Quality Education) and Goal 12 (Responsible Consumption and Production).

Nevertheless, the urgency for future research remains high. Studies are needed to examine the long-term effects of recycling-based creative learning, its adaptability across diverse cultural and socioeconomic contexts, and its scalability in global early childhood education systems. Furthermore, urgent research directions should investigate how recycling art practices can be systematically integrated into curricula worldwide to address pressing global issues such as plastic waste reduction and environmental degradation, while simultaneously fostering 21st-century skills such as creativity, problem-solving, and collaboration in children.

This study not only demonstrates the effectiveness of plastic recycling montage in enhancing creativity but also highlights its relevance for addressing global educational and environmental challenges. Urgent and collaborative international research efforts are required to maximize its potential as a transformative pedagogical practice for sustainable and creative early childhood education worldwide.

AUTHOR CONTRIBUTION STATEMENT

YF was primarily responsible for the conceptualization of the study, development of the research methodology, data collection, data curation, and formal analysis. YF also prepared the initial draft of the manuscript. TY provided supervision throughout the research process, contributed to the validation of the findings, and was responsible for reviewing and editing the manuscript. TY also managed project administration and ensured the overall quality of the study. Both authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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