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The Effect of Mosaic Method Using Grains and Paper on Fine Motor Development of Children Aged 5-6 Years: A Pre-Experimental Study at Raden Patah Kindergarten Surabaya

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ABSTRACT Fine motor development in preschool children is a fundamental element that underpins independence, readiness to learn, and future academic success. However, delayed development in this area is still commonly found, requiring stimulation that is not only educationally appropriate but also enjoyable for children. One approach that is considered effective is the mosaic method, an art activity of arranging tesserae into visual works. This study was conducted to evaluate the effectiveness of using mosaics made from grains and paper in improving fine motor skills in children aged 5 to 6 years. This study applied a pre-experimental research design through a one-group pretest-posttest approach. A total of 30 children were selected as participants using simple random sampling. During a two-week period, the participants received an intervention in the form of mosaic-making activities six times. Data collection was carried out using observation instruments that had been tested for validity and reliability. Initial evaluation results show that 60% of children are at the developing as expected (DaE). However, after routine stimulation, there was a significant jump in performance, with 80% of children achieving the category of very well developed (VwD). Statistical analysis using the Wilcoxon test reinforced these findings with a p-value of 0.000 ($p < 0.05$) and an effect size of 0.875, which is classified as a very strong impact. This scientifically proves that the mosaic method using natural materials such as grains and paper has a major positive impact on honing children's eye-hand coordination. Therefore, this method is highly recommended as an effective, economical, and recreational alternative stimulation medium in early childhood education systems and home care patterns.

INDEX TERMS Preschool children, Fine motor skills, Mosaic method, Grain media and paper, Developmental stimulation

I. INTRODUCTION

Fine motor development is a important element in preschool children's growth that supports independence, readiness to learn, and future academic achievement [1], [2]. This ability involves the coordination of small muscles, especially in the hands and fingers, which are necessary for daily activities such as writing, drawing, cutting, pasting, and self-care [3]. Unfortunately, some parents or educators often overlook motor skills because they prioritize children's cognitive abilities [4]. If these skills do not develop optimally, children are at risk of learning disabilities, low self-esteem, and difficulties interacting in school environments [5].

The WHO reported in 2020 that approximately 5–25% of preschool children experience developmental disorders, including fine motor delays [6]. Data from the Indonesian Ministry of Health in 2020 indicates that around 13% to 18% of children under five years of age (toddlers) experience growth and developmental disorders, a condition that requires early stimulation intervention [7]. Regionally, similar challenges are also seen in East Java, where 2018 Ministry of Health data shows that around 24.5% of preschool children face obstacles in the development of their fine motor skills [8].

Fine motor skills have a significant impact on other dimensions of development [9]. Factors that trigger delays include a lack of stimulation, limited learning media, and the minimal role of parents and teachers in providing stimulation appropriate to the child's age [10]. Stimulation through play has been proven effective in improving children's fine motor skills [11]. One technique that can be taught is the mosaic method [12]. Mosaics are a decorative art that involves arranging and attaching pieces of material to a specific pattern using adhesive [13]. The media used vary, ranging from paper, natural materials, ceramics, to fabric [14]. This method serves as a stimulation medium to optimize children's fine motor skills through activities such as pinching, arranging, and attaching small materials in a mosaic, which trains hand-eye coordination, finger strength, precision, and concentration [15], [16].

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According to developmental stimulation theory, preschool-aged children require targeted and repetitive stimulation to optimize the development of fine motor skills. Meanwhile, the theory of sensorimotor integration emphasizes that manipulative activities such as holding, arranging, and sticking beads can effectively integrate sensory and motor functions, thereby improving hand-eye coordination. In the context of nursing, this approach is also consistent with the principle of family-centered care, as it is easy for parents to apply at home as part of their child's developmental stimulation. Empirical evidence from prior studies demonstrates that mosaic-based activities substantially enhance fine motor proficiency in preschool-aged children [5], [17]. The use of natural materials such as grains and paper offers unique advantages over other mosaic media: they are more environmentally friendly and cost-effective, and they provide a richer sensory experience through variations in texture and shape, thereby enhancing engagement and the effectiveness of stimulation for children's fine motor development. However, the application of structured mosaic methods using a combination of natural materials such as grains and paper is still very limited.

Observations at Raden Patah Kindergarten in Surabaya show that some children aged 5–6 years still have difficulties in fine motor activities such as cutting, pasting, tracing, and folding. In addition, the mosaic method has never been systematically applied in the learning curriculum. Accordingly, this research seeks to investigate how the mosaic method, utilizing paper and grains, influences the fine motor development of children aged 5 to 6 years. This research used a pre-experimental design with a one group pretest-posttest model to measure changes in children's motor development.

This study is expected to contribute to the development of evidence-based education and health related to play interventions. The contributions of this study include:

1. Providing empirical evidence related to the use of grain mosaic and paper methods in optimizing the fine motor development of children aged 5–6 years.
2. Providing an understanding of the mechanism of grain mosaic and paper interventions in influencing children's fine motor development.
3. Providing recommendations on stimulation activities using art or play in education and nursing to improve the development and rehabilitation of children with fine motor disorders.

This article is systematically organized, starting from the background, literature review, previous research, conceptual framework and hypotheses, methodology, results and data analysis, discussion, implications, to suggestions for future research.

II. METHOD

This study applied a one-group pretest-posttest framework in a pre-experimental design to analyze the effect of paper and grain mosaic interventions on the fine motor skills of children aged 5–6 years. This methodology was used to measure the direct impact of the treatment by comparing the participants' fine motor skills before and after the intervention, without involving a control group. This design facilitates understanding of changes in children's development due to intervention while maintaining practicality in the context of nursing and education [18].

A. STUDY DESIGN AND RATIONALE

Using a one-group pretest-posttest approach in a pre-experimental framework, this study examined the effectiveness of using paper and grain mosaics on the fine motor development of children aged 5–6 years. This method focused on assessing changes in the subjects abilities by comparing data collected before and after the intervention was given to a single group [19].

B. STUDY SETTING

This research was conducted at Raden Patah Kindergarten in Surabaya, located at Tandes Lor gang 1/18, Tandes, Surabaya. This school was chosen because of its strategic location and adequate infrastructure for children's learning and play activities. The entire research process, from preparation and implementation to data analysis, was carried out between February through November 2025.

C. PARTICIPANTS AND SAMPLING METHOD

The subjects of this study consisted of 30 children aged 5–6 years at Raden Patah Kindergarten in Surabaya, selected from a single population using simple random sampling with a spin wheel, where the attendance numbers were calculated based on Yamane's formula. The selected participants met the inclusion criteria for participants included good physical health and commitment to participate in the entire intervention program. In addition, the legality of the children's participation was ensured through informed consent or written approval from parents or guardians [18].

D. MATERIALS INTERVENTION

The intervention used a mosaic technique made from grains (corn, soybeans, mung beans) and origami paper. This intervention was conducted over six sessions during two weeks. Each session included an introduction to the tools and materials, a demonstration of mosaic techniques, guided practice, and independent activities for the children under the supervision of the researchers. The theme of the illustrations used is houses and land transportation.

E. DATA COLLECTION INSTRUMENTS AND PROCEDURE

Data for this study was gathered using observation sheets tailored to evaluate children's fine motor development. This instrument was adopted from Febrianingsih's (2014) study and has undergone validity and reliability testing [20]. The process began with a pretest to assess baseline skills through activities like drawing shapes, writing, cutting, and stringing beads. This was followed by a six-session intervention using a mosaic method with grains and paper. Finally, a posttest involving the same tasks was conducted to measure improvements in fine motor skills resulting from the mosaic treatment.

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F. DATA ANALYSIS

The data were obtained in this study were then tested using SPSS version 25.0. Descriptive statistical analysis was used to collect the distribution of children's fine motor development categories at the stages before and after the mosaic intervention. Because the data were ordinal with a paired subject design, the Wilcoxon test was applied to compare pretest and posttest scores. The threshold for statistical significance is set at a p-value < 0.05 to indicate a real impact of the intervention. In addition, Cohen's effect size (r) was calculated to measure the practical impact of the intervention in the field [18], [21].

G. ETHICAL CONSIDERATIONS

This research procedure has obtained ethical certification from the Health Research Ethics Committee (KEPK) of the Surabaya Ministry of Health Polytechnic with approval number EA/3941/KEPK-Poltekkes_Sby/V/2025. All parents or guardians of participants provided written consent before the study began. In its implementation, this research upholds ethical standards toward vulnerable populations by ensuring data confidentiality, participant voluntariness, and Participants have the absolute right to withdraw from the study at any time without penalty or consequence [22].

III. RESULTS

This study was conducted from January through November 2025 at Raden Patah Kindergarten in Surabaya. Raden Patah Kindergarten is an early childhood education institution with A accreditation located at Tandes Lor gang 1/18, Tandes, Surabaya. This location is very strategic with adequate facilities to support children's learning and play processes.

TABLE 1
Frequency Distribution Data of Characteristics of Children Aged 5-6 Years at Raden Patah Kindergarten, Surabaya, September 2025

Characteristic		f	%
Age	60-64 months	1	3,3
	65-68 months	5	16,7
	69-72 months	24	80
Total		**30**	**100**
Gender	Male	18	60
	Female	12	40
Total		**30**	**100**
Father's Education	High School	14	46,7
	University	16	53,3
Total		**30**	**100**
Mother's Education	High School	11	36,7
	University	19	63,3
Total		**30**	**100**
Father's Job	Civil servant	2	6,7
	Private sector employed	24	80
	Entrepreneur	1	3,3
	Chef	1	3,3
	Farmer	1	3,3
	Shipping agent	1	3,3
Total		**30**	**100**
Mother's Job	Civil servant	7	23,3
	Private sector employed	2	6,7
	House wife	14	46,7
	Teacher	3	10
	Manager	1	3,3
	BUMN	2	6,7
	Freelancer	1	3,3
Total		**30**	**100**

According to the information in TABLE 1, almost all (80%) of the children are aged between 69 and 72 months, with a total of 24 children. The gender distribution is dominated by boys, who account for 60% (18 children) compared to girls, who account for 40% (12 children). In terms of parental profiles, the educational level of fathers (53.3%) and mothers (63.3%) was mostly college graduates. Meanwhile, the employment profile showed that the majority of fathers (80%) worked in the private sector, while nearly half of the mothers (46.7%) were housewives.

TABLE 2
Frequency Distribution Data of Fine Motor Development Before Intervention Using the Mosaic Method with Grains and Paper in Children Aged 5-6 Years at Raden Patah Kindergarten in Surabaya in September 2025.

Category	Frequency	%
Starting to Develop (StD)	0	0
Already Developed (AD)	2	6,7
Developing as Expected (DaE)	18	60
Verry Well Developed (VwD)	10	33
Total	**30**	**100**

According to the information presented in TABLE 2, before the intervention using the mosaic method with grains and paper, a small number of children (6.7% or 2 children) were in the Already Developed (AD) category. Meanwhile, the majority of children, namely 18 children (60%), were in the Developing as Expected (DaE) category.

TABLE 3
Frequency Distribution Data of Fine Motor Development After Intervention Using the Mosaic Method with Grains and Paper in Children Aged 5-6 Years at Raden Patah Kindergarten in Surabaya in September 2025

Category	Frequency	%
Starting to Develop (StD)	0	0
Already Developed (AD)	0	0
Developing as Expected (DaE)	6	20
Verry Well Developed (VwD)	24	80
Total	**30**	**100**

According to the information presented in TABLE 3, explaining that the motor development of children after being given intervention using the mosaic method made from grains and paper, a small portion (20%), namely 6 children, were in the developing as expected (DaE) category and almost all (80%), namely 24 children, were in the developing very well (VwD) category. The data results show that, on average, children aged 5-6 years experienced had optimal development after getting the grain and paper mosaic method intervention, where there were significant changes compared to the results before being given the grain and paper mosaic method intervention.

TABLE 4
Wilcoxon Test on Fine Motor Development in Children Before and After Intervention Using a Mosaic Method with Grains and Paper in 5-6 Years Old Children at Raden Patah Kindergarten in Surabaya

Fine Motor Development	f	%	f	%
Starting to Develop (StD)	0	0	0	0
Already Developed (AD)	2	6,7	0	0
Developing as Expected (DaE)	18	60	6	20
Verry Well Developed (VwD)	10	33	24	80
Total	**30**	**100**	**30**	**100**
p-value uji *wilcoxon*		**0,000**		

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According to the findings presented in TABLE 4, shows the results of the Wilcoxon test, which confirms the significant effect of the grain mosaic and paper method intervention on the fine motor development of 5-6 years old children at Raden Patah Kindergarten in Surabaya. The analysis results show a p-value of 0.000 ($p < 0.05$), so H0 is rejeted in favor of the alternative hypothesis (H1). These findings prove that there is a significant difference in fine motor skills between the pre- and post-intervention phases, so it can be concluded that the use of grain and paper mosaic media is effective in optimizing child development.

The magnitude of the impact of the grain and paper mosaic method intervention on the fine motor development of 5-6 years old children was measured using Cohen's effect size formula (r). The calculation results showed a value of 0.875, indicating that this intervention had a significant effect. These findings confirm that the mosaic method provides real benefits for children's fine motor development and is highly feasible for implementation in a broader sample.

IV. DISCUSSION

A. FINE MOTOR DEVELOPMENT OF CHILDREN AGED 5-6 YEARS BEFORE INTERVENTION USING THE

Based on a study at Raden Patah Kindergarten in Surabaya, the pretest results showed that before the mosaic method intervention was implemented, no children (0%) were classified as Starting to Develop (StD) category. Two children (6.7%) were in the Already Developed (AD) category, 18 children (60%) were in the Developing as Expected (DaE) category, and 10 children (33.3%) were in the Very Well Developed (VwD) category. These findings indicate that although the children's fine motor skills were generally good, their achievements were not yet fully optimal. In line with this, Sari and Agustriana (2024) stated that fine motor development is influenced by various factors such as pregnancy history, nutrition, stimulation, and parenting patterns [13].

Based on Gesell's theory, children aged 5-6 years are in the phase of mature eye-hand coordination and fine motor optimal small muscle control [23]. This refinement phase is highly dependent on the quality of adequate nutrition, environmental conditions, and intensive guidance and stimulation [24]. From a cognitive perspective, Piaget places children of this age in the preoperational stage, where their motor skills are not uniform because they are highly dependent on direct experience and frequency of practice [25].

The mosaic method is a stimulating solution to optimize the fine motor skills of young children who still need to hone their skills. By involving finger movements when pinching, gluing, and sticking seeds or paper, children learn to recognize various shapes and textures through sensory means. The benefits of this activity include increased hand muscle flexibility and eye-hand coordination, while encouraging children to express their artistic side through artwork.

B. FINE MOTOR DEVELOPMENT OF CHILDREN AGED 5-6 YEARS AFTER INTERVENTION USING THE MOSAIC METHOD WITH GRAINS AND PAPER

The posttest results after the intervention using the mosaic method with grains and paper showed a significant improvement in children's fine motor skills. There were no children (0%) in the classified Starting to Develop (StD) or Already Developing (AD) categories. Instead, 6 children (20%) reached the Developing as Expected (DaE) category and the majority, namely 24 children (80%), were in the Very Well Developed (VwD) category. This activity effectively trains fine coordination through finger movements when picking up small materials that require dexterity, as well as educating children in collaborating using various materials [26].

These findings are in line with the study by Idhayanti et al (2022), it was stated that fine motor skills in drawing circles, drawing squares, neatness of shape, accuracy of shape, and speed of shape after mosaic intervention (posttest) resulted in 8 children in the Already Developed (AD) category, 8 children in the Developing as Expected (DaE) category, and 2 children in the Very Well Developed (VwD) category [12]. The research by Wulandari et al. (2025) also confirmed that providing mosaic intervention for five sessions effectively improved children's skills in pasting and cutting according to patterns. Through the mosaic method, children intensively trained their eye-hand coordination when arranging and gluing materials onto the available patterns [27].

Parents' educational level has a significant correlation with child development; higher educational attainment is associated with more advanced fine motor skill development in children. Highly educated parents tend to better understand how to create a supportive family environment and harmonious interpersonal relationships [28]. In addition, educational background also influences parenting patterns, as reflected in parents' ability to access essential services such as education, health clinics, or parenting training. This broad understanding enables them to provide an environment conducive to optimal child growth and development [29].

The employment status of parents can have a significant impact on a child's growth and development. Working parents are often an indicator of a family's socioeconomic status, which in turn determines the quality of the environment and the availability of resources to support child development. Factors such as nutritional intake, access to educational play media, and opportunities for children to receive age-appropriate stimulation are closely related to socioeconomic conditions [30]. However, there are challenges in the direct involvement of working mothers in daily activities and supervision of children. Conversely, stay-at-home mothers have greater opportunities to provide the motivation and stimulation needed to hone children's fine motor development [31].

The improvement in scores between the pretest and posttest proves that the mosaic method using grains and paper as media is significantly effective in optimizing children's fine motor development. The activities of pinching and sticking to specific patterns effectively train hand-eye coordination, which in turn strengthens children's fine motor control and concentration. In addition to the physical benefits, this method

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also systematically trains children's patience and accuracy in working.

C. THE EFFECT OF MOSAIC METHOD INTERVENTION USING GRAINS AND PAPER ON THE FINE MOTOR DEVELOPMENT OF CHILDREN AGED 5-6 YEARS

Statistical analysis using the Wilcoxon test yielded a p-value of 0.000 ($p < 0.05$), confirming the acceptance of hypothesis one (H1). These findings confirm the significant impact of the grain and paper mosaic method intervention on strengthening the fine motor development of 5-6 years old children at Raden Patah Kindergarten. The data supports the use of mosaic activities as structured stimulation in optimizing the motor development of early childhood. In addition, the Cohen's effect size (r) value of 0.875 confirms that this intervention exerts a strong influence on the children's fine motor development.

Two separate studies confirm the effectiveness of the mosaic method in stimulating fine motor development in preschool children has been validated by research conducted by Listiarini et al. (2024) and Anugrah et al. (2024). Listiarini's study noted a significant increase in post-intervention average scores ($p = 0.000$), while Anugrah's study proved that the combination of green beans and origami paper had a statistically greater impact than the conventional method in the control group ($p = 0.026$). Both studies concluded that mosaic intervention has a real impact on children's fine motor skills[5], [13].

Optimal fine motor development is crucial because they enable children to perform daily tasks such as writing, drawing, and cutting, all of which require precise muscle control and hand coordination [30]. These skills themselves consist of basic to complex movements that involve the automatic, precise, and rapid coordination of hundreds of muscles [32]. This development is greatly influenced by the environment and stimulation, where repeated practice using the mosaic method has been proven effective in improving it, in line with Skinner's behaviorist theory [32]. Mosaic activities function as targeted stimulation that optimizes various aspects such as small muscle control, visual-motor coordination, concentration, and sensory-motor skills [33]. The Montessori concept further explains this effectiveness through the ideas of self-construction (self-formation through direct experience), sensitive periods (critical phases when children are receptive to fine motor stimulation), and absorbed mind (intensive absorption of sensory-motor experiences), all of which support the importance of hands-on activities such as mosaics for training children's precision and finger movement control.

V. CONCLUSION

Research on the application of the grain and paper mosaic method at Raden Patah Kindergarten in Surabaya proved the effect of this intervention in improving the fine motor development of children aged 5-6 years old. Before the treatment, the majority of children were in the Developing as Expected (DaE) category, but after the intervention there was a significant increase where almost all children reached the Very Well Developed (VwD) category. The significance of this impact is reinforced by the results of the Wilcoxon statistical test with a p-value of 0.000 and an effect size of 0.875, which shows that the mosaic method has a large and positive influence on children's fine motor development.

This study can be applied in the field of nursing as a therapy to enhance and optimize children's fine motor development. Future researchers are advised to use different research designs, such as including a control group and extending the observation period to gain a more detailed understanding of the process of children's fine motor development.

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DECLARATIONS

ETHICAL APPROVAL

This research was conducted in accordance with research ethics guidelines and has obtained approval from the Health Research Ethics Committee (KEPK) of the Surabaya Ministry of Health Polytechnic with approval number EA/3941/KEPK-Poltekkes_Sby/V/2025. All parents or guardians of child participants provided written consent before the study began. The identity and anonymity of participants were strictly maintained, and each stage of the research was conducted based on the principles and guidelines of research ethics applicable to human subjects.

CONSENT FOR PUBLICATION PARTICIPANTS.

Written informed consent was secured from all participants for the dissemination of this study's findings.

COMPETING INTERESTS

The authors state that no competing interests influenced the conduct or the findings of this research.

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