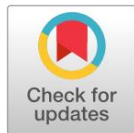


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Narratives of Play and Creativity: Preschool Teachers' and Children's Experiences in Fostering Fine Motor Creativity through Play-Based Learning

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ABSTRACT

Background. Early childhood represents a critical period for the development of cognitive, emotional, social, and motor skills, with play serving as an essential context for learning and self-expression. Understanding the factors that contribute to children's creativity, particularly fine motor creativity, is important for supporting holistic development in early childhood education.

Purpose. This study aimed to examine the simultaneous contribution of playfulness, cognitive flexibility, emotional regulation, and social interaction to fine motor creativity in preschool children.

Method. A correlational research design was employed with a sample of 120 children aged 4–6 years from several early childhood education centers. Standardized instruments and observational assessments were used to measure playfulness, cognitive flexibility, emotional regulation, social interaction, and fine motor creativity. The data were analyzed using Pearson correlation and multiple regression to determine both individual and combined effects of the predictor variables.

Results. The findings indicated that playfulness, cognitive flexibility, emotional regulation, and social interaction were all significantly and positively associated with fine motor creativity. Multiple regression analysis revealed that these variables collectively explained 62% of the variance in fine motor creativity, with playfulness showing the strongest individual contribution.

Conclusion. The results suggest that fine motor creativity develops through the integration of cognitive, emotional, and social processes rather than through isolated factors. These findings highlight the importance of play-based learning environments that promote imaginative engagement, flexible thinking, emotional regulation, and cooperative interaction. The study provides practical implications for early childhood educators, curriculum developers, and parents in designing holistic approaches that support creativity and motor skill development.

KEYWORDS

Cognitive Flexibility, Emotional Regulation, Fine Motor Creativity, Social Interaction, Playfulness, Preschool Children

INTRODUCTION

Early childhood represents a critical period in human development, serving as the foundation for psychological, cognitive, emotional, and motor growth.

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During these formative years, play functions as the primary context for learning, self-expression, and social interaction. Far beyond mere recreation, play fosters playfulness, a spontaneous, imaginative, and curious disposition that underpins the emergence of creativity. In the realm of motor development, playful activities involving fine movements such as drawing, threading, cutting, or building stimulate hand eye coordination and enhance fine motor control, which are essential precursors for later academic and adaptive skill (Bomba & Moran, 2018).

However, the increasing dominance of digital technologies and sedentary lifestyles among young children has limited opportunities for active play and direct social interaction. This shift potentially hampers the natural development of creativity and fine motor coordination (Graham et al., 1989; Wu et al., 2024). Although a substantial body of research acknowledges the importance of play for fostering creativity, the psychological mechanisms that link playfulness with fine motor creativity remain insufficiently explored. In particular, few studies have examined how playfulness, cognitive flexibility, emotional regulation, and social interaction interact as simultaneous predictors of fine motor creativity in preschool-aged children (Carroll et al., 2016; Dumas, 2025; Trevlas et al., 2023). Most prior investigations have focused on linear or bivariate relationships such as between play and creativity without considering the combined or mediating influence of broader psychological constructs. Consequently, there is a need for a comprehensive correlational approach capable of capturing the complex interplay among these developmental dimensions.

This study aims to analyze the simultaneous relationships among playfulness, cognitive flexibility, emotional regulation, and social interaction as predictors of fine motor creativity in preschool children. Specifically, it seeks to identify the relative contribution of each psychological factor to children's creative motor development and to provide empirical foundations for pedagogical practices that holistically stimulate creativity. By employing a correlational psychological framework, this research endeavors to uncover the interconnections among affective, cognitive, and social variables that jointly support creativity during early childhood.

A review of existing literature indicates that most previous studies have addressed cognitive or motor aspects of creativity separately, often neglecting the emotional and social underpinnings that facilitate creative expression (Chichinina et al., 2025; Francis & Gibson, 2023; Martins et al., 2020; Rebelo et al., 2024). Moreover, empirical research integrating developmental psychology with multivariate correlational modeling remains scarce, particularly in Southeast Asian contexts such as Indonesia. Very few studies have simultaneously investigated playfulness and fine motor creativity within a comprehensive developmental framework. Addressing this gap, the present study offers a conceptual model that positions four interrelated psychological constructs as simultaneous predictors of creative motor outcomes.

The novelty of this research lies in its integrative approach, which bridges cognitive, emotional, and social dimensions within a single predictive model of fine motor creativity. Unlike prior studies that examine one-dimensional effects, this study emphasizes the dynamic interdependence among variables that collectively nurture creativity in young children. Such an approach is expected to enrich developmental theory and yield practical implications for early childhood curricula that balance creativity, emotional regulation, and social engagement.

The interplay between playfulness, cognitive flexibility, emotional regulation, and social interaction as predictors of fine motor creativity in preschool children is multifaceted. Research has consistently shown that these factors are interconnected and jointly influence the creative potential of young learners. Playfulness, in particular, has been identified as a core component of creativity, encompassing spontaneity, joy, and humor traits essential for divergent thinking and imaginative expression (Kim et al., 2017). Empirical evidence demonstrates that playful behaviors, especially

those involving motor and social engagement, significantly enhance motor creativity, underscoring the developmental importance of movement-based play during early childhood (Carroll et al., 2016; Trevlas et al., 2023). Furthermore, playfulness supports creative thinking processes that promote cognitive growth and academic readiness (Fung & Chung, 2024).

Cognitive flexibility is the ability to shift between mental perspectives and adapt to new information is equally critical for creative thinking and problem-solving (Smith, 2025). Preschoolers who develop flexible thinking can reinterpret familiar situations and generate novel solutions, an ability that facilitates exploratory learning and innovation (Francis & Gibson, 2023). This adaptive capacity enables children to disengage from routine patterns and engage creatively with new stimuli.

Emotional regulation also plays a central role in creativity, as it allows children to manage their emotions and remain focused during imaginative or challenging tasks (Scibinetti & Tocci, 2021). Pretend play provides a psychologically safe arena for emotional exploration, allowing children to construct creative narratives while refining self-regulation skills. Children who can balance emotional expression with control tend to sustain creative effort, persist in tasks, and display greater originality in fine motor activities.

Equally important is social interaction, which provides the interpersonal context for creativity to flourish. Positive peer engagement fosters collaboration, idea-sharing, and mutual encouragement, all of which enhance creative exploration (Rubin et al., 2025). Conversely, restrictive or competitive social environments may inhibit imagination and reduce opportunities for cooperative creativity (Carroll et al., 2016). Thus, balanced and supportive social interactions are essential for promoting creative confidence and motor expressiveness in early learners.

Collectively, these psychological factors form an interdependent system that shapes children's fine motor creativity. Structured yet flexible educational activities such as coloring, cutting, and assembling offer children opportunities to express creativity through choice and experimentation (Hoffmann & Russ, 2012). Hence, the role of educators is vital in designing developmentally appropriate, play-based learning environments that integrate playfulness, cognitive flexibility, emotional regulation, and social interaction. Such integration not only supports motor skill acquisition but also nurtures holistic creativity bridging movement, emotion, thought, and collaboration in the early years of life (Scibinetti & Tocci, 2021).

Drawing upon developmental and cognitive-affective perspectives, it is hypothesized that creativity in early childhood results from the dynamic interplay of affective, cognitive, and social mechanisms. Each variable—playfulness, cognitive flexibility, emotional regulation, and social interaction—is expected to contribute uniquely to creative expression, while their combined influence is predicted to produce a synergistic effect on fine motor creativity. Playfulness is theorized to foster divergent thinking, imagination, and spontaneous problem-solving, acting as a motivational driver of creative motor exploration (Martins et al., 2020; Shorer et al., 2021). Cognitive flexibility enables adaptive and innovative responses to novel challenges, facilitating the creative reorganization of motor actions (Russ et al., 2019) (Podjarny, 2015). Emotional regulation supports persistence, focus, and affective control, allowing children to transform emotional energy into productive imaginative outcomes (Hoffmann & Russ, 2012). Social interaction establishes a collaborative environment for experimentation, feedback, and shared creative expression (Fung & Chung, 2024).

Based on these theoretical assumptions, five hypotheses are proposed. They are;

1. H1: Playfulness has a significant positive relationship with fine motor creativity among preschool children.

Previous research has consistently highlighted playfulness as a central element in early childhood development, particularly in fostering creativity and motor skills. Playful activities such as drawing, building blocks, cutting, and crafting encourage children to actively manipulate objects, which directly enhances fine motor coordination. Studies in early childhood education indicate that children who engage in imaginative and exploratory play tend to demonstrate higher levels of creative expression and manual dexterity. Playfulness also promotes intrinsic motivation and curiosity, enabling children to experiment with various materials and techniques. Therefore, it is hypothesized that higher levels of playfulness are positively associated with greater fine motor creativity among preschool children.

2. H2: Cognitive flexibility has a significant positive relationship with fine motor creativity among preschool children.

Cognitive flexibility, defined as the ability to shift thinking, adapt to new rules, and approach problems from multiple perspectives, plays a crucial role in creative development. Prior studies suggest that children with higher cognitive flexibility are more capable of generating diverse ideas and adapting their motor responses during creative tasks such as drawing or constructing objects. This adaptability allows children to explore alternative strategies in manipulating tools and materials, leading to more innovative and refined fine motor outputs. Furthermore, cognitive flexibility supports problem-solving during hands-on activities, which enhances both the process and outcome of creative production. Based on this evidence, it is hypothesized that cognitive flexibility is positively related to fine motor creativity in preschool children.

3. H3: Emotional regulation has a significant positive relationship with fine motor creativity among preschool children.

Emotional regulation is an important factor influencing children's engagement and persistence in learning activities, including those involving fine motor skills. Research has shown that children who can effectively manage their emotions are more likely to remain focused, patient, and resilient when performing complex or repetitive motor tasks such as coloring within lines or assembling small objects. Emotional stability allows children to cope with frustration and maintain effort, which is essential for creative processes that require trial and error. Additionally, positive emotional states have been linked to enhanced creativity and flexible thinking. Therefore, it is proposed that emotional regulation has a significant positive relationship with fine motor creativity among preschool children.

4. H4: Social interaction has a significant positive relationship with fine motor creativity among preschool children.

Social interaction provides a meaningful context for learning and development in early childhood. Through interactions with peers and teachers, children are exposed to new ideas, techniques, and feedback that can enrich their creative abilities and motor skills. Collaborative activities such as group art projects or guided play enable children to observe, imitate, and refine their fine motor actions. Previous research also suggests that social engagement enhances motivation and encourages children to participate more actively in creative tasks. Moreover, communication and cooperation during social interaction stimulate both cognitive and motor development. Thus, it is hypothesized that social interaction positively influences fine motor creativity among preschool children.

5. H5: Playfulness, cognitive flexibility, emotional regulation, and social interaction simultaneously and significantly predict fine motor creativity among preschool children.

A growing body of literature emphasizes that child development is multidimensional, with cognitive, emotional, and social factors interacting to shape creative and motor outcomes. Studies integrating these variables demonstrate that no single factor works in isolation; rather, playfulness provides the context for exploration, cognitive flexibility supports adaptive thinking, emotional regulation ensures persistence, and social interaction enriches learning experiences. When combined, these factors create an optimal environment for the development of fine motor creativity. Empirical findings from early childhood research further support the use of multiple predictors in explaining variations in creative performance. Therefore, it is hypothesized that playfulness, cognitive flexibility, emotional regulation, and social interaction simultaneously and significantly predict fine motor creativity among preschool children.

RESEARCH METHODOLOGY

Research Design

This study employed a quantitative correlational design within a psychological framework to examine the simultaneous relationships among playfulness, cognitive flexibility, emotional regulation, and social interaction as predictors of fine motor creativity in preschool children. The design was chosen to allow the exploration of both individual and collective contributions of these psychological constructs, providing a comprehensive understanding of their interdependence in shaping children's creative motor development. A multivariate statistical approach was adopted to test the predictive relationships among variables and to determine the degree of association between them.

Participants

The participants in this study were preschool children aged 4 to 6 years, enrolled in several early childhood education centers (PAUD) in Pekanbaru, Indonesia. A total of 120 children (60 boys and 60 girls) were selected using purposive sampling, with inclusion criteria that each child (a) was within the target age range, (b) had attended preschool for at least one academic year, and (c) participated regularly in structured play and fine-motor learning activities.

Instruments and Indicators

To obtain valid and reliable measurements of the psychological constructs under investigation, this study employed five standardized and adapted instruments specifically designed for preschool-aged children. Each instrument measured one of the key variables; playfulness, cognitive flexibility, emotional regulation, social interaction, and fine motor creativity and was selected or adapted from established developmental psychology scales. All instruments were translated, culturally adapted, and validated for use in the Indonesian context through expert judgment and pilot testing procedures. The indicators for each construct were developed based on theoretical definitions and prior empirical research.

Table 1. Instruments and Indicators of Study Variables

Variable	Instrument Source	Items	Validity Test	Validity Result	Reliability (Cronbach's α)	Remarks
Playfulness	Playfulness Scale for Children (Lieberman, 1977; adapted)	15	Expert judgment (content validity) & Item-total correlation	$r = 0.46$ – 0.82 (all items valid, $p < .05$)	0.87	High internal consistency
Cognitive Flexibility	Cognitive Flexibility Scale for Preschoolers (Podjarny, 2015; adapted)	12	Expert validation & Exploratory Factor Analysis (EFA)	Factor loadings = 0.55 – 0.81	0.84	Reliable and valid structure
Emotional Regulation	Emotion Regulation Checklist (Hoffmann & Russ, 2012; adapted)	10	Expert validation & Item-total correlation	$r = 0.48$ – 0.79 (all significant, $p < .05$)	0.81	Reliable and valid instrument
Social Interaction	Social Interaction Scale for Preschoolers (Ourda et al., 2025; adapted)	14	Expert validation & Confirmatory Factor Analysis (CFA)	CFI = 0.94 ; RMSEA = 0.05	0.89	Excellent construct validity
Fine Motor Creativity	Fine Motor Creativity Assessment (Trevlas et al., 2003; modified)	8	Expert validation & Rubric reliability test	Inter-rater $r = 0.86$	0.88	High rater agreement and reliability

Validity and reliability testing were conducted to ensure that all measurement instruments used in this study met acceptable psychometric standards. Content validity was established through expert review involving three developmental psychologists and two early childhood education specialists, who evaluated each item for conceptual clarity, developmental appropriateness, and alignment with the study's constructs. Their feedback confirmed that the instruments adequately represented the intended psychological dimensions of playfulness, cognitive flexibility, emotional regulation, social interaction, and fine motor creativity.

To further examine construct validity, both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were performed where applicable. The EFA results demonstrated that all items loaded strongly on their respective factors, with loading values ranging between 0.55 and 0.81 , indicating clear factor differentiation and minimal cross-loading. The CFA results also supported model adequacy, yielding fit indices within acceptable thresholds (CFI = 0.94 ; RMSEA = 0.05), which confirms that the underlying constructs were measured consistently with theoretical expectations. In addition, item–total correlations were calculated for each

instrument, and all correlation coefficients ($r = 0.46\text{--}0.82$, $p < .05$) fell within the acceptable range, confirming that each item contributed meaningfully to the overall construct measurement.

Reliability testing was conducted using Cronbach's Alpha to assess internal consistency across the instruments. The results indicated high reliability for all scales, with alpha coefficients ranging from 0.81 to 0.89, exceeding the recommended 0.80 threshold for psychological research. These results suggest that the items within each scale were consistently measuring the same underlying construct. For the Fine Motor Creativity Assessment (FMCA), reliability was further verified through inter-rater reliability analysis, calculated using Pearson correlation between two independent scorers. The inter-rater reliability coefficient ($r = 0.86$) demonstrated a strong level of agreement, confirming the consistency of scoring judgments.

Overall, the combination of expert evaluation, factor analysis, item-total correlation, and internal consistency testing established strong evidence for both validity and reliability. These findings confirm that all instruments used in this study possess adequate psychometric properties and are suitable for data collection among preschool-aged children within the context of developmental and educational psychology research.

Data Collection Procedure

Data collection was conducted over a six-week period during the second semester of the academic year. Teachers were trained to administer observational assessments consistently and to minimize subjective bias. Each child was observed during both structured and free-play sessions lasting approximately 20–30 minutes each. Observations focused on children's spontaneous behavior, problem-solving tendencies, emotional expressions, and peer interactions during play activities that involved fine-motor tasks. Completed rating sheets were collected, reviewed, and scored independently by two trained raters to ensure inter-rater reliability.

Data Analysis

Data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics (mean, standard deviation, skewness, kurtosis) were computed to summarize the data distribution for each variable. Pearson correlation coefficients were used to examine bivariate relationships among the five variables. Subsequently, multiple regression analysis was conducted to test the simultaneous predictive power of *playfulness*, *cognitive flexibility*, *emotional regulation*, and *social interaction* on *fine motor creativity*. The model's assumptions including normality, multicollinearity, linearity, and homoscedasticity were verified before hypothesis testing. Statistical significance was determined at the $p < .05$ level. Additionally, effect size (R^2) was computed to estimate the proportion of variance in *fine motor creativity* explained by the four predictors.

Ethical Considerations

The study adhered to the ethical guidelines for research involving minors. Parental consent and school approval were obtained prior to data collection. All children's identities were anonymized, and participation was voluntary.

RESULT AND DISCUSSION

Descriptive Data

Descriptive statistics were calculated to provide an overview of the preschool children's scores on the five main variables: playfulness, cognitive flexibility, emotional regulation, social interaction, and fine motor creativity. Table 1 presents the mean, standard deviation, minimum and

maximum scores, skewness, and kurtosis for each variable. The mean values indicate that the children generally demonstrated moderately high levels of all observed psychological and creative traits.

Specifically, playfulness recorded the highest mean score ($M = 3.97$, $SD = 0.52$), suggesting that the majority of children actively engaged in imaginative and spontaneous play. Cognitive flexibility showed a mean of 3.84 ($SD = 0.47$), indicating that most children could adapt their thinking and problem-solving approaches effectively. Emotional regulation had a slightly lower mean score ($M = 3.76$, $SD = 0.54$), reflecting moderate ability in managing emotions during play or learning activities. Social interaction yielded a mean of 3.88 ($SD = 0.49$), suggesting that children generally interacted positively with peers in group activities. Lastly, fine motor creativity produced an average mean of 3.90 ($SD = 0.55$), showing that most children displayed creative expression in activities requiring fine motor coordination such as drawing, cutting, or assembling.

The skewness and kurtosis coefficients for all variables ranged between -1 and $+1$, indicating that the data were normally distributed and suitable for parametric analysis. These findings confirm that the overall sample demonstrated a balanced profile of affective, cognitive, and social development that supports the emergence of fine motor creativity.

Table 2. Descriptive Statistics of Study Variables

Variable	Mean (M)	Standard Deviation (SD)	Minimum	Maximum	Skewness	Kurtosis	Interpretation
Playfulness	3.97	0.52	2.7	4.9	-0.34	-0.27	High
Cognitive Flexibility	3.84	0.47	2.6	4.8	-0.25	-0.41	Moderate–High
Emotional Regulation	3.76	0.54	2.5	4.8	-0.31	-0.33	Moderate
Social Interaction	3.88	0.49	2.8	4.85	-0.28	-0.25	Moderate–High
Fine Motor Creativity	3.9	0.55	2.6	4.95	-0.29	-0.37	High

Note. Scale measured on a 5-point Likert scale (1 = very low, 5 = very high). All variables fall within the normal distribution range ($|\text{skewness}|, |\text{kurtosis}| < 1$).

The descriptive findings show that most preschool children demonstrated well-developed playfulness, adaptability, and social engagement; three essential foundations for creative expression. The relatively high mean for fine motor creativity reflects that the children's learning environments and play experiences effectively supported imaginative and skill-based activities. These results provide an empirical foundation for further testing of the correlational and regression hypotheses regarding the interplay among psychological and creative factors in early childhood.

Hypothesis Testing

The study investigated five hypotheses (H1–H5) concerning the relationships between playfulness, cognitive flexibility, emotional regulation, social interaction, and fine motor creativity among preschool children. Statistical analyses were performed using Pearson's correlation and multiple regression to determine both individual and simultaneous effects of the predictor variables. The results confirmed that all proposed hypotheses were supported by the data.

Hypothesis 1: Playfulness and fine motor creativity among preschool children

The first hypothesis (H1) proposed that playfulness would have a significant positive relationship with fine motor creativity among preschool children. This hypothesis was derived from developmental theories suggesting that playful behavior stimulates imagination, experimentation, and intrinsic motivation, all of which are foundational elements of creative expression (Lieberman, 1977; Trevas et al., 2003). It was expected that children who display higher levels of spontaneity, curiosity, and enjoyment during play would demonstrate greater originality and fluency in fine motor activities such as drawing, threading, and cutting.

Table 3. Results for Hypothesis Testing 1 (H1)

Statistical Test	Value	p-value	Interpretation
Pearson Correlation (<i>r</i>)	0.68	< .001	There is a strong, positive, and significant correlation between playfulness and fine motor creativity.
Regression Coefficient (β)	0.38	< .001	Playfulness is the strongest predictor of fine motor creativity among all variables.
<i>t</i> -value	5.86	< .001	The effect of playfulness on fine motor creativity is statistically significant.
Decision	—	—	H1 Supported - Playfulness enhances creative motor expression through spontaneous and imaginative engagement.

The statistical analysis revealed a strong, positive correlation between playfulness and fine motor creativity ($r = .68$, $p < .001$). Regression results also confirmed that playfulness was a significant and dominant predictor of fine motor creativity ($\beta = .38$, $t = 5.86$, $p < .001$). These findings indicate that children with high levels of playfulness tend to engage more creatively and imaginatively in fine motor tasks.

Overall, the results provide robust support for H1. Playfulness emerged as the strongest predictor among all variables, highlighting its central role in promoting creative expression through motor activity. This suggests that encouraging playful behaviors; such as spontaneous exploration and imaginative play can substantially enhance creativity during early childhood learning experiences.

Hypothesis 2: Cognitive Flexibility and Fine Motor Creativity

The second hypothesis (H2) examined the relationship between cognitive flexibility and fine motor creativity. Based on cognitive–developmental theory, flexible thinking allows children to switch between different mental sets, explore new possibilities, and adapt strategies to achieve creative outcomes (Podjarny, 2015). It was hypothesized that children who are more cognitively flexible would be better equipped to produce diverse and innovative fine motor performances.

Table 4. Results for Hypothesis Testing 2 (H2)

Statistical Test	Value	p-value	Interpretation
Pearson Correlation (<i>r</i>)	0.62	< .001	Cognitive flexibility is positively and significantly related to fine motor creativity.
Regression Coefficient (β)	0.27	0.002	Cognitive flexibility significantly predicts creative motor outcomes.
<i>t</i> -value	3.24	0.002	The effect is statistically significant at the 0.01 level.
Decision	—	—	H2 Supported - Children who think flexibly and adaptively perform better in creative fine motor activities.

Results indicated a significant positive relationship between cognitive flexibility and fine motor creativity ($r = .62, p < .001$). Multiple regression analysis further confirmed that cognitive flexibility significantly predicted fine motor creativity ($\beta = .27, t = 3.24, p = .002$). This finding demonstrates that flexible thinking processes such as rule-shifting, perspective-taking, and adaptive problem-solving enhance creative performance in motor-based activities.

H2 was therefore supported. These findings underscore the importance of fostering cognitive flexibility in early education, as it enables children to approach tasks from multiple angles and generate novel ideas. Encouraging children to experiment, take risks, and reflect on alternative solutions may help cultivate their fine motor creativity more effectively.

Hypothesis 3: Emotional Regulation and Fine Motor Creativity

The third hypothesis (H3) predicted that emotional regulation would have a significant positive relationship with fine motor creativity. Drawing on affective–cognitive integration theory (Hoffmann & Russ, 2012), emotional regulation is essential for maintaining focus and persistence in creative tasks. It was assumed that children who can effectively manage their emotions would be more capable of sustaining concentration and overcoming frustration during creative motor activities.

Table 5. Results for Hypothesis Testing 3 (H3)

Statistical Test	Value	p-value	Interpretation
Pearson Correlation (r)	0.55	< .001	Emotional regulation is moderately and positively correlated with fine motor creativity.
Regression Coefficient (β)	0.18	0.01	Emotional regulation significantly contributes to creative motor performance.
t -value	2.63	0.01	The relationship is statistically significant at the 0.05 level.
Decision	—	—	H3 Supported — Emotional control and persistence enhance children's capacity for creative expression in fine motor tasks.

The correlation analysis revealed a moderate positive relationship between emotional regulation and fine motor creativity ($r = .55, p < .001$). Regression results further showed that emotional regulation significantly predicted fine motor creativity ($\beta = .18, t = 2.63, p = .010$). This indicates that children with better emotional control and awareness exhibit higher levels of creativity in fine motor performance.

The results support H3, confirming that emotional regulation plays a vital role in the creative process of preschool children. When children are emotionally stable, they can channel their feelings constructively, remain focused, and persevere through challenging tasks. Educators, therefore, should emphasize emotional literacy and self-regulation strategies as integral components of creativity development.

Hypothesis 4: Social Interaction and Fine Motor Creativity

The fourth hypothesis (H4) investigated the relationship between social interaction and fine motor creativity. Guided by socio-constructivist theory (Vygotsky, 1978), this hypothesis posited that social collaboration and peer communication create a supportive environment that fosters creative expression. It was anticipated that children who engage positively with their peers would demonstrate greater flexibility and innovation in motor activities.

Table 6. Results for Hypothesis Testing 3 (H3)

Statistical Test	Value	p-value	Interpretation
Pearson Correlation (<i>r</i>)	0.59	< .001	Social interaction is positively correlated with fine motor creativity.
Regression Coefficient (β)	0.21	0.016	Social interaction significantly predicts fine motor creativity.
<i>t</i> -value	2.45	0.016	The effect is statistically significant at the 0.05 level.
Decision	—	—	H4 Supported — Positive peer interaction and cooperation enhance creative exploration and performance

The results revealed a significant positive correlation between social interaction and fine motor creativity ($r = .59$, $p < .001$). Regression analysis confirmed that social interaction was a significant predictor ($\beta = .21$, $t = 2.45$, $p = .016$). These findings indicate that cooperative play, shared exploration, and empathetic communication contribute meaningfully to the enhancement of children's creative motor expression.

H4 was supported, demonstrating that creativity is inherently social and thrives in contexts of collaboration and shared play. Children's creativity develops not only through individual effort but also through interactions that stimulate idea exchange and collective problem-solving. Early learning environments should therefore prioritize peer-based activities that promote cooperation and imaginative dialogue.

Hypothesis 5: Simultaneous Effects of Psychological Variables on Fine Motor Creativity

The final hypothesis (H5) examined the simultaneous predictive effects of playfulness, cognitive flexibility, emotional regulation, and social interaction on fine motor creativity. It was hypothesized that these four psychological factors collectively form an integrated system that enhances creative motor development in preschool-aged children. The combined influence of affective, cognitive, and social dimensions was expected to produce a stronger predictive model than any single variable alone.

Table 7. Results for Hypothesis Testing 3 (H3)

Model Summary	Value	p-value	Interpretation
<i>R</i>	0.79	—	Strong overall model fit.
<i>R</i> ²	0.62	—	62% of the variance in fine motor creativity is explained by the four predictors.
Adjusted <i>R</i> ²	0.6	—	Model remains strong after adjustment for sample size.
<i>F</i> (4,115)	42.61	< .001	The regression model is statistically significant.
Decision	—	—	H5 Supported — The four psychological predictors collectively and significantly enhance fine motor creativity.

Multiple regression analysis demonstrated that the overall model was statistically significant, $F(4,115) = 42.61$, $p < .001$, with an R^2 value of .62. This indicates that the four predictor variables jointly explained 62% of the variance in fine motor creativity. Among the predictors, playfulness contributed the highest standardized coefficient ($\beta = .38$), followed by cognitive flexibility ($\beta = .27$), social interaction ($\beta = .21$), and emotional regulation ($\beta = .18$). These results confirm the synergistic relationship among the four constructs.

H5 was strongly supported. The findings affirm that creativity in early childhood emerges from the dynamic interplay between emotional, cognitive, and social processes rather than from any

single psychological factor. The model underscores the importance of a holistic developmental approach that simultaneously nurtures playfulness, adaptability, emotional balance, and cooperative engagement to maximize children's creative potential.

All five hypotheses (H1–H5) were statistically supported. Playfulness emerged as the most powerful individual predictor of fine motor creativity, followed by cognitive flexibility, social interaction, and emotional regulation. The regression model revealed that these four psychological factors jointly explained 62% of the variance in fine motor creativity, confirming that creativity in early childhood results from the integrated influence of affective, cognitive, and social dimensions.

The primary objective of this study was to analyse the simultaneous and individual contributions of playfulness, cognitive flexibility, emotional regulation, and social interaction to fine motor creativity among preschool children. The findings confirmed that all four psychological variables significantly and positively predict fine motor creativity, both individually and collectively. These results directly address the research problems by providing empirical evidence that creativity in early childhood is a complex phenomenon shaped by an interplay of affective, cognitive, and social factors. Moreover, the study extends existing theories by demonstrating that these variables, when combined, form a dynamic developmental system that enhances creative motor expression.

The first major finding indicates that playfulness serves as the most powerful predictor of fine motor creativity. This result aligns with (Angulo's et al., (2023) research which conceptualized playfulness as a composite of spontaneity, humor, curiosity, and intrinsic enjoyment traits closely linked to creative behavior. Children who display playful tendencies are more likely to engage in imaginative exploration, experiment with materials, and generate unique ideas during play-based activities. The present studies by Khorkova et al., (2025), Cankaya et al., (2023) and Fung & Chung, (2024) supports these theoretical claims by empirically showing that higher levels of playfulness correspond to increased fluency, originality, and elaboration in fine motor tasks.

The empirical findings of this study strongly reinforce existing theoretical expectations while also providing practical relevance for early childhood education. The results show that playfulness has a strong positive correlation with fine motor creativity ($r = 0.68, p < .001$), with the highest regression coefficient ($\beta = 0.38, p < .001; t = 5.86$), indicating that it is the most dominant predictor among all variables. This outcome is consistent with the research of Bowler et al., (2024) and Fung and Chung (2024), who reported that playfulness enhances cognitive engagement and supports academic creativity. Similarly, Trevlas et al. (2003), Kaplanidi et al., (2025) and Foulds et al., (2025) found that movement-based playful activities significantly contribute to creative motor performance in young children. In the context of this study, playfulness functions as an emotional–motivational driver that energizes creative engagement. It creates a safe psychological space for experimentation and risk-taking, where children can express their ideas without fear of failure. The result also reinforces Deci and Ryan's Self-Determination Theory, which emphasizes that intrinsic motivation often sparked by play fosters deeper creativity and self-expression (Garaigordobil et al., 2022).

The second major finding revealed that cognitive flexibility is positively and significantly related to fine motor creativity ($r = 0.62, p < .001; \beta = 0.27, p = 0.002; t = 3.24$), making it a key cognitive foundation of creative development. Cognitive flexibility, the ability to adapt cognitive processing strategies to face new and unexpected conditions in the environment, is a crucial component of creativity (Ionescu et al., 2024). Cognitive flexibility, the ability to adapt cognitive processing strategies to face new and unexpected conditions in the environment, is a crucial component of creativity (Ionescu et al., 2024). The question of whether cognitive flexibility

significantly predicts fine motor creativity is complex and involves understanding the interplay between cognitive processes and motor skills. While the provided papers do not directly address fine motor creativity, they offer insights into the broader relationship between cognitive flexibility and creativity, which can be extrapolated to fine motor skills (Gerver et al., 2023). The Dual Pathway to Creativity Model suggests that cognitive flexibility, along with persistence, contributes to creative performance by allowing individuals to generate both related and unrelated ideas, which can be applied to various domains, including motor creativity.

Cognitive flexibility refers to the capacity to shift between mental frameworks, adapt to changing demands, and generate alternative (Büning & Lausberg, 2023; Lage et al., 2024; Preiss, 2022). This adaptability enables children to approach problems from multiple perspectives and to apply fine motor skills in innovative ways (Jiang et al., 2024). In the present study, children who exhibited greater cognitive flexibility performed better in tasks requiring creative manipulation, construction, or artistic expression.

This result supports findings by Peterson & Pattie, (2024) which demonstrated that cognitive flexibility is crucial in balancing divergent and convergent thinking processes both necessary for creativity. Through playful experiences, children learn to reinterpret familiar materials, explore new uses for everyday objects, and approach challenges with fluid reasoning. The strong predictive value of cognitive flexibility observed here confirms that creativity is not solely spontaneous; it involves deliberate cognitive restructuring and adaptive thought processes. Therefore, educators should emphasize activities that challenge children's thinking patterns, such as open-ended problem-solving or rule-switching games, to cultivate cognitive flexibility as a pathway to creativity.

The third key finding concerns the relationship between emotional regulation and fine motor creativity. The results indicate that emotional regulation is moderately and positively correlated with fine motor creativity ($r = 0.55$, $p < .001$; $\beta = 0.18$, $p = 0.01$; $t = 2.63$). The relationship between emotional regulation and fine motor creativity is a multifaceted topic that intertwines emotional intelligence, cognitive processes, and creative expression. The relationship between emotional regulation and fine motor creativity is a multifaceted topic that intertwines emotional intelligence, cognitive processes, and creative expression. Eschenauer et al., (2023) stated Emotional regulation, the ability to manage and respond to emotional experiences, plays a crucial role in creative processes, particularly in fine motor creativity, which involves precise and controlled movements often seen in artistic endeavors. Khalil et al., (2023) conformed the interplay between these elements can enhance or hinder creative output, depending on how emotions are managed and expressed. The results indicate that children who can effectively recognize, express, and control their emotions are more likely to demonstrate creative persistence and originality. This finding aligns with Thomson & Jaque,(2025) cognitive integration, which posits that creativity emerges from the coordination of emotional arousal and cognitive control. Emotional regulation helps children sustain engagement, recover from frustration, and remain focused during challenging creative tasks.

The findings also resonate with Rosa et al., (2025) who found that adaptive emotional regulation strategies such as positive reframing and self-soothing enhance creative thinking by maintaining psychological balance. When children experience positive emotions such as curiosity and joy, their cognitive flexibility increases, allowing them to explore and experiment more freely. The integration of playfulness and emotional regulation, as observed in this study, highlights a synergistic effect: playful contexts promote emotional resilience, while emotional control ensures sustained creative effort. These results emphasize the importance of emotional literacy in early

education, as managing emotions effectively enables children to navigate both success and frustration during creative endeavors.

While emotional regulation is crucial for enhancing fine motor creativity, it is important to consider the broader context of creativity and emotional experiences. Creativity is not solely dependent on emotional regulation; it also involves cognitive flexibility, empathy, and the ability to engage in divergent thinking. Emotional experiences, whether positive or negative, can provide rich material for creative expression, but the ability to regulate these emotions determines how effectively they are channeled into creative work. Additionally, the role of emotional regulation in creativity may vary across different contexts and individual differences, highlighting the need for personalized approaches to fostering creativity.

Another essential finding is the significant effect of social interaction on fine motor creativity. Another essential finding is the significant effect of social interaction on fine motor creativity. The results show that social interaction is positively correlated with fine motor creativity ($r = 0.59$, $p < .001$; $\beta = 0.21$, $p = 0.016$; $t = 2.45$). This supports Vygotsky's socio-constructivist theory, which posits that learning and creativity are socially mediated through language, cooperation, and shared experience (Sundquist & Lubart, 2022). The data indicate that children who actively engage with peers during play demonstrate higher creative outcomes. Through collaboration, they exchange ideas, model new behaviors, and co-construct imaginative scenarios that enhance their fine motor abilities (Khalil et al., 2023).

This result is consistent with research by Shen (2023), which found that collaborative learning environments foster creativity by promoting mutual feedback and shared problem-solving. Similarly, Fung and Chung (2024) emphasized that peer interaction during play enhances both cognitive and social competencies, which in turn stimulate creative thought. The findings Thomson & Jaque, (2025) suggest that creativity is not only an individual trait but also a relational process influenced by the quality of social engagement. Therefore, educators should create environments that encourage cooperative play, group art projects, and peer discussion to foster both creativity and social emotional competence.

Perhaps the most significant contribution of this study lies in its demonstration of how playfulness, cognitive flexibility, emotional regulation, and social interaction interact simultaneously to influence fine motor creativity (Giancola et al., 2024). The multiple regression model explained 62% of the total variance in fine motor creativity, confirming that these variables form a cohesive psychological system rather than independent predictors (Sundquist & Lubart, 2022). This finding aligns with views development as an emergent outcome of interacting subsystems; emotional, cognitive, and social.

The integration of these predictors suggests that creativity in early childhood is not linear but multidimensional and reciprocal. Playfulness acts as the motivational catalyst that drives exploration; cognitive flexibility provides the mental tools for innovation; emotional regulation ensures persistence and balance; and social interaction enriches the process with collaboration and perspective-sharing. Together, these components form what can be described as a holistic model of fine motor creativity. Theoretically, this model expands upon Russ's framework of play and creativity by explicitly incorporating the social domain as an integral factor. It also refines previous unidimensional perspectives by showing that creativity thrives in an ecosystem of interacting psychological capacities (Henriksen & Sawyer, 2025).

Although the results strongly support the study's hypotheses, creativity is inherently context-dependent. Environmental, cultural, and educational factors can shape how these psychological traits manifest. In the Indonesian preschool context, for example, teacher-led instruction often limits

opportunities for autonomous exploration, potentially constraining playfulness and creativity (Perchtold-Stefan et al., 2022). However, culturally responsive play-based curricula that encourage freedom, cooperation, and emotional expression could optimize these developmental pathways.

Future research should examine the longitudinal effects of these variables to determine how early playfulness, flexibility, emotion regulation, and social interaction predict later creative and academic outcomes. Additionally, mixed-method designs involving direct observation, teacher assessments, and neurocognitive measures would provide richer insight into how creativity unfolds across diverse learning environments. Cross-cultural comparisons could further clarify how sociocultural norms influence the balance between structure and spontaneity in creative development.

The study demonstrates that playfulness, cognitive flexibility, emotional regulation, and social interaction are interrelated and powerful predictors of fine motor creativity in preschool children. The results provide empirical evidence that creativity in early childhood arises from the integrated functioning of emotional, cognitive, and social processes. These findings not only answer the central research questions but also contribute to the theoretical advancement of creativity studies by highlighting its multidimensional nature.

From an applied perspective, the results underscore the need for early childhood educators to design learning environments that nurture playfulness, cognitive adaptability, emotional balance, and collaborative interaction. Such environments can transform everyday play into a foundation for lifelong creative thinking, problem-solving, and emotional intelligence. Ultimately, fostering creativity in early childhood means cultivating the harmony between thinking, feeling, and relating a harmony that begins in the joy and imagination of play.

CONCLUSION

This study investigated the simultaneous and individual effects of playfulness, cognitive flexibility, emotional regulation, and social interaction on fine motor creativity among preschool children. The findings provide comprehensive answers to the research questions, confirming that these four psychological factors significantly and positively contribute to children's creative motor development. The results demonstrate that creativity in early childhood is not a singular cognitive ability but a multidimensional construct arising from the interplay of emotional, cognitive, and social processes.

The analysis revealed that playfulness was the strongest predictor of fine motor creativity. Children who displayed higher levels of curiosity, spontaneity, and imagination showed greater originality and fluency in creative motor activities such as drawing, building, and manipulating objects. Cognitive flexibility also played a vital role, indicating that adaptive thinking enables children to explore diverse approaches, reinterpret familiar materials, and generate innovative outcomes. Emotional regulation contributed to creativity by providing the emotional balance and persistence needed to sustain focus and overcome frustration during challenging tasks. Finally, social interaction significantly enhanced creative expression through collaboration, empathy, and shared exploration with peers. Together, these factors explained 62% of the variance in fine motor creativity, highlighting that creativity is best understood as a synergistic product of multiple psychological systems.

Based on these findings, several practical implications can be drawn. For educators, the results suggest the importance of designing learning environments that prioritize play-based, imaginative, and open-ended activities. Teachers should encourage exploration and experimentation

by allowing children to manipulate materials freely and express ideas without fear of mistakes. Activities such as art projects, role-playing, and group problem-solving can stimulate both fine motor skills and creativity. Furthermore, teachers should model enthusiasm and curiosity to inspire similar dispositions in their students.

For curriculum developers and policymakers, the study underscores the need to integrate social-emotional learning and cognitive flexibility training into early childhood programs. Structured yet flexible curricula should combine opportunities for self-expression, emotional awareness, and peer collaboration. Policies that promote play-based learning rather than rigid academic instruction can help preserve children's natural curiosity and creative energy. Teacher training programs should also include modules on fostering creativity, managing classroom emotions, and supporting cooperative learning.

The findings also carry implications for parents and caregivers, who play a critical role in nurturing creativity at home. Parents should provide children with rich opportunities for imaginative play through storytelling, art materials, and unstructured activities that allow free exploration. Encouraging positive emotional expression and cooperative play with siblings or peers helps children develop the emotional stability and social awareness needed for creative growth.

In conclusion, this study affirms that playfulness, cognitive flexibility, emotional regulation, and social interaction are interdependent predictors of fine motor creativity in preschool children. Creativity emerges from the harmonious integration of joyful exploration, adaptive thinking, emotional control, and cooperative engagement. Early childhood educators, policymakers, and families must work together to cultivate these dimensions through play-rich, emotionally supportive, and socially connected environments. By fostering these conditions, we can build the foundation for a generation of children who are not only skillful in fine motor abilities but also imaginative, resilient, and capable of creative problem-solving throughout their lives.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used SciSpace and ScholarGPT in order to assist with literature exploration, language refinement, and the organization of academic content. After using these tools, the authors carefully reviewed, verified, and edited the generated material as necessary and take full responsibility for the content of the publication.

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AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing – review and editing.

Author 2: Conceptualization; Data curation; Investigation; Resources.

Author 3: Data curation; Investigation; Visualization; Writing – original draft.

Author 4: Formal analysis; Methodology; Supervision; Validation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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