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**The Relationship between Games, Creativity, and Numeracy Skills in
Elementary School Students**

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THE RELATIONSHIP BETWEEN GAMES, CREATIVITY, AND NUMERACY SKILLS IN ELEMENTARY SCHOOL STUDENTS

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Abstract

Shifting from handcrafted to digital and factory-made toys has sparked worries about primary students' fading creativity and numeracy skills. This mixed-methods study explores the relationship between children's play and their creativity and numeracy achievements. The qualitative strand involved interviews with teachers and traditional toy artisans, capturing cultural practices, learning contexts, and observed skills during play. Qualitative results support these themes, showing that traditional play stimulates verbal interactions related to reasoning and problem-solving, particularly in spatial reasoning and mathematics. The quantitative results indicate that play frequency significantly predicts both creativity ($\beta = 0.62, p < 0.001$) and numeracy ($\beta = 0.71, p < 0.001$), explaining 78% and 86% of the variance, respectively. Traditional and modern non-digital games have positive effects, whereas digital games have significant negative effects. Path analysis further reveals a significant correlation between creativity and numeracy ($r = 0.84, p < 0.001$). Concerning the models that consider play type, the results show that traditional play consistently supports both outcomes. Digital play tends to exhibit negative impacts, and modern non-digital play contributes positively, albeit to a lesser extent. The tapestry of both data types deepens the conclusion that play, especially when culturally situated, nurtures cognitive development.

Keywords: Contemporary Games; Traditional Games; Creativity; Numeracy Skill.



A. Introduction

The transformation of children's play from traditional, handmade activities to factory-produced and digital games has been a global phenomenon in the digital age (Seungyeon & Seongcheol, 2024; Thoidis et al., 2022). In Indonesia, particularly in Aceh, this shift is marked by a decreasing engagement with traditional games rich in cognitive and social value, accompanied by a growing preference for digital entertainment (Hidayati, 2020; Kurniawati & Sutharjana, 2023). Such changes raise serious concerns about their potential impact on two fundamental domains of child development: creativity and numeracy (Ball et al., 2014; Gittens, 2015). In the past, traditional games in Aceh were embedded in everyday life, providing natural opportunities for mathematical thinking, problem-solving, and collaboration. As these activities diminish, questions emerge regarding the extent to which modern games—particularly those that are factory-made or technology-based—alter the developmental trajectory of children's cognitive skills.

While previous studies have examined the negative impacts of digital play on cognitive skills (Fastame & Melis, 2020; Ramani & Scalise, 2020), fewer have distinguished between the type of games played (traditional vs. modern) and the frequency with which children engage in them. Existing research often treats "play" as a single, undifferentiated category, thereby obscuring how the nature of the activity itself influences developmental outcomes. Moreover, play has historically been considered a key context for learning by doing, in which children internalize abstract concepts through concrete experiences and social interaction (Rico et al., 2020). The loss of such contexts in the digital era may have profound consequences for children's ability to develop creativity and numeracy in culturally and socially meaningful ways.

Previous studies frequently adopt a single-focus approach: some emphasize the potentially detrimental effects of modern digital games on creativity and numeracy (Depascale et al., 2023; Fastame & Melis, 2020), while others highlight the benefits of frequent play in fostering cognitive development regardless of type (Hidayati, 2020; Michela & Francesca, 2012). This has led to conceptual ambiguity in understanding whether the type of

play, the frequency, or their interaction more strongly predicts creativity and numeracy outcomes. Furthermore, the lack of attention to moderating variables such as parenting style and socioeconomic background – which may influence children’s access to certain play types and educational value – further complicates the picture (Mues et al., 2022). Evidence from other domains suggests that parents’ beliefs and engagement are crucial mediators of children’s learning outcomes, especially in numeracy and mathematical reasoning (Husen & Mansor, 2018; Putri et al., 2022). The integration of Islamic values into mathematics learning through culturally relevant media, such as comics, also shows how contextual factors shape cognitive engagement (Putri et al., 2022; Romano & Etim-Andy, 2023).

This study addresses the shortcomings in previous research on the impact of factory-made toys and technology-based games on children’s creativity and numeracy skills. Specifically, this research investigates how these two types of games affect children’s cognitive skills more deeply and holistically by isolating various important, often overlooked variables (Khodeir et al., 2018). Many previous studies have yet to account for factors such as the type of game, duration of use, socioeconomic background, and the role of parental supervision, all of which can significantly impact the research outcomes (Mues et al., 2022). In line with recent scholarship on the role of science process skills and digital literacy in shaping student competencies (Astalini et al., 2024; Darmaji et al., 2022), the present study examines not only the direct relationship between play and cognitive skills but also the moderating influences of home environment and parental oversight. By doing so, it seeks to offer more precise and practical insights for educators, parents, and policymakers on effectively managing factory-made and technology-based games to enhance children’s creativity and numeracy development.

In Aceh, the cultural repertoire of traditional games – such as kite-making, *congklak*, and *engklek* – contains embedded mathematical concepts in measurement, geometry, and problem-solving. These games are not merely leisure activities but constitute a form of informal, culturally grounded education that stimulates both cognitive and social competencies (Peláez-



Ospina et al., 2024). However, these games are increasingly being replaced by mass-produced digital toys, which may limit opportunities for hands-on creativity and social interaction (Ledang & Asshagab, 2024). Observational evidence and parental reports indicate that children who engage more frequently in traditional or modern non-digital play tend to display higher levels of creative thinking and numeracy skills (Oktavia et al., 2024; Anggraeni & Emi, 2025). This finding echoes the broader literature on STEAM education, which underscores how creative, hands-on, and collaborative activities enhance students' problem-solving abilities and innovative thinking (Zaqiah et al., 2024). It also resonates with research on critical thinking in elementary education, which highlights the importance of contextual and interactive learning experiences in fostering higher-order cognitive skills (Sasmita et al., 2023).

These observations raise a critical question: How do the type and frequency of play, individually and interactively, influence children's creativity and numeracy in the Aceh context? Addressing this question is vital for understanding children's cognitive development in a specific cultural setting and informing broader debates on play-based learning and educational equity. It is particularly salient in regions like Aceh, where local wisdom and Islamic values remain integral to community life and schooling practices. Studies on integrating Islamic values into science and mathematics learning (Nurwati et al., 2024) show that culturally responsive pedagogy can enhance students' scientific literacy and engagement. Similarly, research on gender and critical thinking in science process skills (Darmaji et al., 2022) and on mathematics anxiety among undergraduate students (Zanabazar et al., 2023) suggests that a complex interplay of affective, cultural, and experiential factors shapes cognitive performance. These findings underscore the importance of examining children's play as a cognitive activity and a socio-cultural phenomenon.

This study thus lies in the unique research object of handmade traditional games in Aceh and employs a combination of thorough qualitative and quantitative approaches. The research confirms and extends previous findings by integrating direct observation, in-depth interviews, and

a large-scale survey of parents. It presents a new perspective on how traditional games can be practical educational tools that support numeracy and creativity development in primary school children. It aligns with international calls for inclusive and culturally grounded early childhood education that fosters foundational skills and creative capacities (Chapman & O’Gorman, 2022; Grotlüschen et al., 2020). Moreover, by situating its analysis within the Acehnese context, the study contributes to the global conversation on how local traditions can inform modern educational practices, offering insights for countries grappling with similar tensions between digital technology and cultural heritage.

By providing robust, context-sensitive evidence, this study offers educators, parents, and policymakers a clearer roadmap for leveraging traditional and modern play to enhance children’s cognitive skills while respecting and revitalizing local cultural practices. It therefore aims to examine the relationship between the type and frequency of traditional, modern non-digital, and digital games and the development of creativity and numeracy skills among primary school children in Aceh. It also analyzes the moderating roles of parental supervision and socio-economic background.

B. Method

This study uses a mixed-methods sequential exploratory design (Creswell & Vicki L, 2011). It begins with a qualitative stage to explore themes related to children’s play activities and their implications for cognitive development, followed by a quantitative stage to test these findings on a larger sample. The two phases were integrated using a connecting strategy, whereby qualitative themes were transformed into quantitatively measurable indicators in the survey instrument.



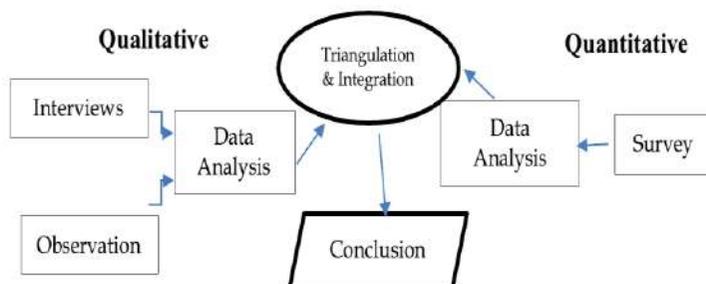


Figure 1: Sequential exploratory mixed methods (Creswell & Vicki L, 2011)

The sample characteristics in this study consisted of two stages. In the qualitative stage, the study involved 20 informants consisting of parents, teachers, and community leaders, who were selected purposively based on their active involvement in children’s play activities. Meanwhile, in the quantitative stage, the study involved 621 parents of elementary school students in Aceh from 647 respondents, with 26 data points eliminated because they were incomplete. This quantitative sample represents urban and rural areas, with children aged 6 to 12.

Data collection techniques in this study were carried out using two approaches. In the qualitative stage, data were obtained through participatory observation for two months in five schools and community locations and in-depth interviews with semi-structured guidelines to explore experiences and perceptions related to children’s play activities. In the quantitative stage, data were collected using an online questionnaire consisting of three sections: measuring weekly play duration, identifying the most dominant types of games played by children, and assessing children’s creativity and numeracy through a pre-designed scale.

Informants were purposively selected based on their active involvement in children’s play activities. Observations were conducted over two months in five community and school locations, representing urban and rural areas. All qualitative data were recorded, transcribed, and analyzed using open coding and thematic analysis techniques to identify dominant patterns and themes related to children’s creativity and

numeracy. The findings of this stage were used to design the survey instrument for the quantitative stage.

Table 1. Mapping of qualitative themes to questionnaire indicators and items

Qualitative Theme	Derived Indicator	Instrument Source
Digital play dominance	Frequency of mobile/console game use	Self-developed
Persistence of traditional games in rural areas	Engagement in traditional games (e.g., congklak, engklek)	Self-developed
Perceived educational value of play	Parental belief in the role of play in creativity and numeracy	Self-developed
Time allocation between study and play	Ratio of daily time spent on play vs. study	Self-developed
Collaborative play and problem-solving	Ability to work in teams and adapt strategies	Torrance Test of Creative Thinking
Parental supervision of play	Frequency and nature of monitoring children's play	Self-developed
Exposure to numeracy-related games	Engagement in play involving counting/measurement	Early Grade Mathematics Assessment

The integration of qualitative and quantitative components followed a connecting strategy, in which themes from interviews and observations were systematically converted into survey indicators to ensure contextual relevance and construct validity. Key themes included digital play among urban children, persistence of traditional games in rural areas, parental beliefs about the educational value of play, time allocation between study and leisure, cooperative play for problem-solving, parental supervision, and exposure to numeracy-related games.

Qualitative data were transcribed and analyzed thematically through open coding to identify dominant patterns. Using linear regression and path analysis, quantitative data were examined to test relationships between play frequency/ type and children's creativity and numeracy. All regression assumptions were met (normality, multicollinearity, homoscedasticity), and



potential rater bias was minimized through triangulation across parents, teachers, and field observations.

The study was conducted according to established ethical guidelines for research involving children. Participation was voluntary, and informed consent was obtained from parents. School authorities granted permission. Respondents were assured of confidentiality, and all identifying information was anonymized before analysis.

C. Results and Discussion

These results outline an important change from traditional forms of play to modern digital games, suggesting reduced creativity, physical, and social engagement during education. This study aims to illustrate the processes involved in creating simple traditional toys and how these processes enhance children's creativity and numeracy skills. Looking from the angle of parental guidance, children are encouraged to create toys and play, which underscores the need to support and encourage the attainment of numeracy skills. The survey of parental attitudes toward industrially produced and digital games raises important worries about the decline of creativity and numeracy.

1. Results

a. Primary school students' numeracy achievement

Numeracy skills are important to primary school-aged children, impacting their academic achievement and daily activities. There is rising concern for children, however, due to the development of technology and a shift from traditional forms of play to digital games. The concern of math in this context is highlighted by the recent National Assessment results for primary school students from Aceh, where many students perform below minimum competency standards in numeracy skills. The data displays a regression in students' basic mathematical reasoning skills, particularly measurement, estimation, and logical problem solving. Such findings point to a diminishing influence of play-based learning, especially through

traditional games, as a potential reason for stagnating or declining foundational numeracy skills among young learners.

Table 2. Achievement of Aceh's primary school students' numeracy in 2021-2023

Indicator	Value	Achievements
Numeracy ability	1.57	Below minimum competency
Proportion of learners with proficient numeracy skills	1.7%	Advanced
Proportion of learners with proficient numeracy skills	28.3%	Proficient
Proportion of learners with Basic numeracy skills	50.71%	Basic
A proportion of learners with numeracy skills needs special intervention	19.29%	Needs Special Intervention

Source: Indonesian National Assessment (<https://data.kemendikdasmen.go.id/>)

Table 2 illustrates the primary school students' numeracy achievement in Aceh from 2021 to 2023 along specific indicators. The findings show that the average score in numeracy is 1.57, which is categorized as threshold deficient, "Below Minimum Competency". Numeracy is only observed in 1.7% of students classified as "Advanced". 28.3% of students belong to "Proficient", representing partial achievement. Most 50.71% of students are in the "Basic" tier, showing basic numeracy competencies. Additionally, 19.29% of students are categorized as "Needs Special Intervention", suggesting that targeted improvement strategies are necessary to augment their numeracy skills. These findings call for prioritizing education quality concerning basic numeracy competencies in Aceh, particularly for students below the minimum threshold and those requiring targeted intervention.

b. The concept of math as it applies to traditional toys

Traditional toys contain a variety of mathematical concepts that can help children understand and develop their numeracy skills in a fun and interactive way. Integrating traditional toys into learning can increase children's interest and understanding of mathematics. As observed among children still accustomed to making simple toys, some have played with toys produced by artisans or factories.



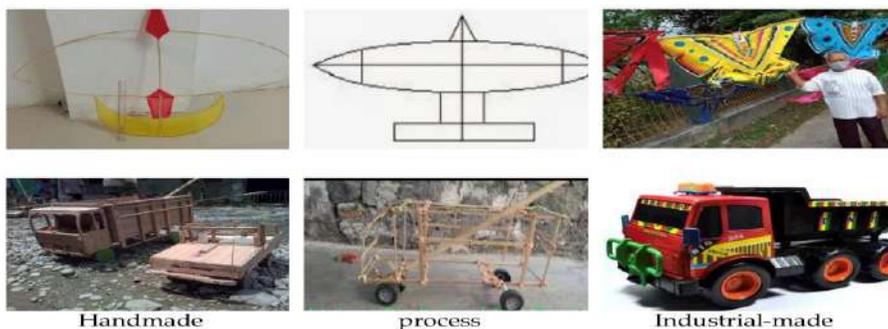


Figure 2. Transformation of a toy

Toy transformation refers to the evolution and innovation in toys' design, materials, and functionality, reflecting changes in technology, culture, and educational practices. This transformation has seen toys evolve from simple, handcrafted objects to highly sophisticated and often digitally integrated products.

“Nowadays, children prefer toys that can be used immediately, especially those with lights or sounds. Rarely do they want to make their own, like in the old days. If I sell wooden cars or traditional spinning tops, adults buy them for collections, not children”. (Interview with RH, May 5, 2024)

The interviews with vendors of children's toys in Aceh traditional markets and shopping centers indicate that there has been a significant shift in children's behavior. They noted that currently, children are more likely to be interested in purchasing deluxe-ready toys featuring popular characters, electronics, and digital media rather than making their own toys like kites, wooden cars, or fern seeds (*congklak*). This condition shows that the culture of play that was once full of motor activities, creativity, and social interaction is now replaced by consumptive and passive patterns, which have the potential to impact the decline of children's cognitive skills, including creativity and numeracy.

Traditional handmade and industrially produced toys contain mathematical concepts such as geometric shapes, patterns, grouping, and measurement. However, mass-produced games limit children's exploration and creativity, so numeracy concepts are not optimally internalized through

play activities. This finding is reinforced by an interview with a kite craftsman in Aceh, who pointed out that making kites involves technical skills and concrete mathematical thinking. In the process, children are involved in measuring length and width, ensuring symmetry of the shape, calculating the inclination angle, and estimating the area and balance so that the kite can fly stably.

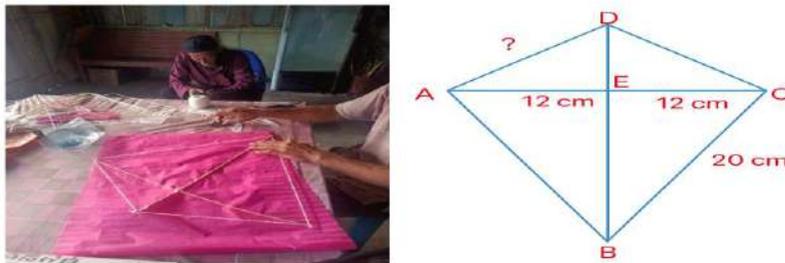


Figure 3. Integration of math concepts in kite making

Figure 3 shows a traditional craftsman performing a manual kite-making process. This activity implicitly shows the involvement of complex yet natural numerical skills, reflecting the integration of mathematical concepts in local cultural practices. During manufacturing, the craftsman must accurately measure the bamboo slats, ensure the kite structure is symmetrical, calculate the angles between joints, and determine the surface area and balance point to ensure the kite flies stably. These activities are tangible forms of applying numeracy skills - especially in measurement, geometry, estimation, and comparison - without using digital measuring tools or formal procedures. The interview was conducted with Mr. HM, a kite craftsman in Pidie District, Aceh, who has been involved in the craft for over two decades. He explained that each stage of making a kite requires careful calculation so the kite can fly balanced and stable in the air.

“You cannot just make an overpass. The length of the bamboo must be the same on both sides. If not, the kite will tilt. The angles must also be just right; I usually measure with a rope or use my trained sense. If the paper is too heavy or the size is not balanced, the kite will not rise” (Interview with HM, March 15, 2024).

The activity supported the research that indicated that traditional handmade toys could be used as an embedded learning tool, which enhanced children's learning experience as they directly engaged with ratios of basic mathematics. Traditional toys, like kites, are valuable because physical activities stimulate children's logical thinking, problem-solving skills, and spatial imagination, unlike digital games, which are passive and instantly gratifying. Thus, this distinct photographic record has an intrinsic worth as a reinforcement for the research's key claim: the transition from tradition-bound ritual to performative art in some contexts.

Although teachers recognize that primary grade learners should have foundational numeracy skills, many still grapple with effectively teaching numeracy within a contextual and practical framework. Despite advancements in pedagogy, many schools continue teaching mathematics within a deeply entrenched rote learning paradigm fixed on formulaic memorization and irrelevant to learners' lives. As a result, learners have minimal understanding of mathematics's practical applications in everyday life. This is made worse by the declining participation of children in traditional games that naturally involve numeracy, estimation, symmetry, and comparison. The absence of play and learning integration in schools is why students' numeracy skills develop piecemeal.

Teachers have attributed such practices to students' understanding of mathematics being easier when they actively participate in making culturally based toys and games, although their teaching approaches have been different. Hence, it becomes necessary to investigate how numeracy-based play activities like kite-making can be primary learning strategies in mathematics. A teacher at one of the public primary schools in Langsa has taught Mathematics for over a decade. During the interview, she described how one of the hardest difficulties in teaching mathematics for her in the contemporary classroom is having learners grasp the more abstract concepts of size, angle, and symmetry in the real world.

“Children often find it difficult to picture what 90 degrees is or how to measure length accurately, because they lack the experience. If it is only through pictures in books, it is easy to forget....” (Interview with LS, May 11, 2024)

Lestari posted that when learners were invited to make a kite using paper and bamboo, they were more enthusiastic and grasped the concept much quicker. In her opinion, such activities help learners appreciate that mathematics is not only on paper and during tests, but in everything they create and play around with.

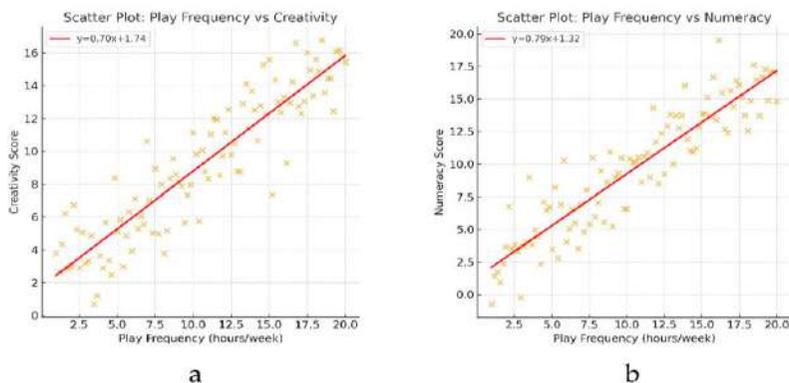
“I have been trying to get students to make kites when studying measurement and symmetry”, he says. “The results are very positive. They understand side length, balance, and shape more in four-sided geometry. In fact, students who are usually passive become more active...”. (Interview with LS, Aceh, May 11, 2024)

The interviews revealed that playing with local culture as a theme can provide a bridge linking mathematics learning with children’s real-life experiences. Therefore, support for integrating local culture into formal learning, in this case, for developing children’s numeracy skills, is fundamental. The results indicate that contextualized learning via traditional play activities enhances learners’ comprehension of numeracy concepts and fosters engagement and innovation in the learning processes. Incorporating this strategy in the primary school curriculum can enrich children’s cognitive development, especially in mathematics.

c. Relationship game with creativity and numeracy

This section shows all the descriptive and inferential findings from the children’s play survey on parents and guardians from around Aceh Province. The survey aimed to investigate the children’s playing behavior, their engagement with different types of traditional and modern toys, and their impact on their thinking skills, especially in creativity and mathematics. We asked the parents and caregivers to assess the different types of play their children participate in, the frequency of participation, and the perceived developmental value of the play activities.





Picture 4. Correlation between play frequency, creativity, and numeracy

Figure 4a. Shows a strong positive linear relationship between play frequency and children's creativity scores. The regression line with the equation $y = 0.70x + 1.74$ explains that every 1-hour increase in play per week is associated with an average increase of 0.70 points in creativity scores. This regression coefficient is statistically significant ($p < 0.001$), with the data distribution fairly tightly clustered around the trend line, indicating consistency in the relationship. This supports the finding that the more often children engage in play activities, the higher their tendency to produce original, flexible, and elaborate ideas.

Figure 4b. also shows a very strong positive linear pattern. The regression equation $y = 0.79x + 1.32$ shows that each additional hour of play per week correlates with a 0.79 point increase in numeracy scores. The greater slope of the line compared to the creativity model indicates that the frequency of play has a stronger impact on numeracy than creativity. This relationship is supported by the high R^2 value in the regression analysis, which explains that a large proportion of the variation in numeracy scores can be predicted from playing frequency.

The findings from these two scatter plots agree with Vygotsky's cognitive development theory and the contextual learning approach, which highlight the role of social interactions and first-hand experiences to foster children's cognitive development (Light, 2017). This data supports the case that whether traditional or modern, non-digital play presents an opportunity to engage in meaningful

learning experiences involving counting, measurement, geometry, estimation, and contextual problem-solving. Also consistent with the international evidence on play-based learning, as evidenced in the PISA/ OECD framework, where countries that follow a more experienced and game-oriented pedagogy report higher numeracy performance. Hence, the findings of this research are useful to the Aceh context and globally in that other game types associated with numeracy and creativity in learning can be treated as reference points.

However, it should be noted that this positive relationship does not necessarily apply to all types of games. Additional analysis of the multiple regression model in this study shows that traditional and modern non-digital games more consistently have a positive impact. In contrast, digital games tend to show a negative pattern. Therefore, the scatter plot findings should be understood as general evidence of the importance of playing frequency, with the caveat that the quality and type of game remain significant differentiating factors.

Table 3. Linear regression creativity and numeracy

Predictor Variable	Creativity (β)	Sig.	Numeracy (β)	Sig.
Play Frequency	0.62	<0.001	0.71	<0.001
Type of Traditional Games	0.27	0.004	0.31	0.002
Type of Modern Non-digital Games	0.18	0.021	0.22	0.018
Type of Digital Games	-0.24	0.013	-0.28	0.009
R²	0.78		0.86	

The regression model provides a robust explanation of the relationship between play and children's cognitive outcomes, as indicated by the high coefficients of determination ($R^2 = 0.78$ for creativity and $R^2 = 0.86$ for numeracy). Play frequency is the most powerful predictor, suggesting that regular play engagement significantly enhances divergent thinking skills and basic numeracy. This finding underlines the general importance of play as a consistent stimulus for children's cognitive growth.

When the type of play is examined, a differentiated pattern emerges. Traditional games positively affect creativity ($\beta = 0.27$, $p = 0.004$) and



numeracy ($\beta = 0.31$, $p = 0.002$), indicating their strong potential to cultivate problem-solving, contextual mathematics, and imaginative thinking. Modern non-digital games also exert positive and statistically significant effects ($\beta = 0.18$ – 0.22), albeit smaller in magnitude, which may reflect their capacity to foster logical reasoning and spatial skills without the same cultural and collaborative depth as traditional play.

In contrast, digital games display significant negative coefficients ($\beta = -0.24$ for creativity; $\beta = -0.28$ for numeracy), suggesting that higher engagement in digital play is associated with reduced levels of divergent thinking and numeracy proficiency. The attribute is attributed to many digital games' repetitive, reward-driven, and less socially interactive nature, which limits opportunities for creative exploration and contextualized problem-solving.

Overall, the regression results highlight two key insights: first, the frequency of play universally benefits children's creativity and numeracy; second, the type of freedom matters considerably, with traditional games showing the most favorable outcomes and digital games raising concerns that warrant further investigation. This fundamentally strengthens the case for including play-based learning in early childhood education policies and practices, particularly traditional, tactile, and culturally situated play. These findings also add to the existing discourse on holistic education in developing contexts by emphasizing the role of play frequency as an important factor in cognitive development.

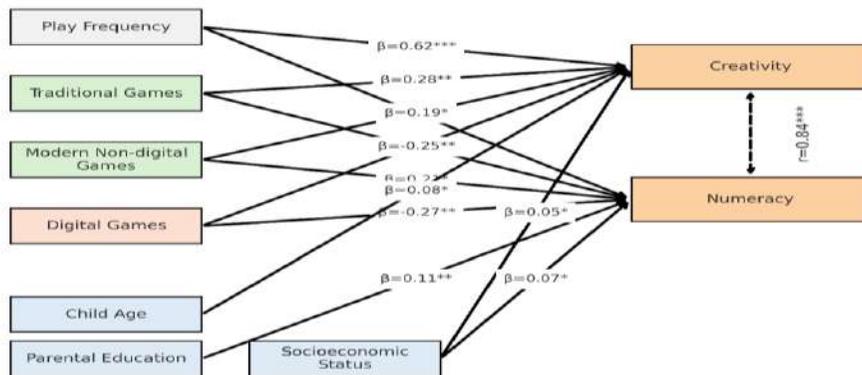


Figure 5. Effect of play frequency on creativity and numeracy

The figure above presents a model of the SEM analysis results showing the effect of playing frequency and game type on children’s creativity and numeracy. Playing frequency is the strongest predictor, with a significant positive contribution to creativity ($\beta = 0.62$; $p < 0.001$) and numeracy ($\beta = 0.71$; $p < 0.001$). The type of game shows a different pattern: traditional games have a consistent positive effect ($\beta = 0.28$ – 0.32), modern non-digital games also have a positive effect, albeit smaller ($\beta = 0.19$ – 0.21), while digital games show a significant negative effect ($\beta = -0.25$ to -0.27). Control variables such as child age, parental education, and socioeconomic status also had a positive effect, although relatively lower than the main variables. In addition, the very strong relationship between creativity and numeracy ($r = 0.84$; $p < 0.001$) confirms that these two skills develop in parallel. Overall, this model supports the argument that both the frequency and type of play are important in children’s cognitive development, highlighting the need for special attention to the effects of excessive digital play.

2. Discussion

This study reveals that the frequency and type of children’s play constitute powerful predictors of creativity and numeracy development. Rather than simply confirming previous research, these findings sharpen our understanding of how culturally embedded and tactile experiences contribute to cognitive growth compared with digital play environments. By combining

quantitative and qualitative strands, this research moves beyond single-focus studies. It demonstrates that traditional games in Aceh – such as *congklak*, *engklek*, and kite-making – act as living laboratories where children internalise measurement, geometry, estimation, and collaborative problem-solving skills. This adds a new dimension to the literature on play-based learning by showing how local cultural practices can be empirically linked to cognitive outcomes and proposing a framework that integrates the frequency and quality of play as interacting variables in developing creativity and numeracy.

A central insight emerging from the analysis is that play serves as a leisure activity and a mechanism of embodied cognition, where ideas are learned through action and social interaction. In this study, children engaged in traditional games displayed enhanced flexibility of thought and a deeper contextual grasp of numeracy (Aprinastuti, 2020; Qirom & Dadang Juandi, 2023). At the same time, those immersed in digital play showed reduced opportunities for creative exploration and real-world problem-solving. These findings resonate with Vygotsky's social constructivism, which emphasises that higher mental functions develop first in the social sphere before becoming internalised (Topçiu & Myftiu, 2015). In line with this theory, the observed relationship between social interaction and physical manipulation of materials in traditional games appears to provide a richer scaffolding for cognitive development than many digital games' passive, reward-driven structure (Atem et al., 2024; Hapsari & Labib, 2025). This extends existing frameworks by illustrating how culturally situated play can act as informal scaffolding, bridging the gap between spontaneous activity and scientific understanding in children's mathematics learning.

While clear in the descriptive statistics, the contrast between traditional and digital play becomes theoretically meaningful when interpreted through contextual learning. Hands-on activities such as kite-making or *engklek* require children to measure, compare, and estimate; they also cultivate teamwork and negotiation skills that align with the collaborative dimensions of 21st-century competencies (Zaqiah et al., 2024). These activities starkly contrast with many digital games, which reward speed and repetitive responses rather

than sustained reflection, thus potentially stifling divergent thinking and numerical reasoning (Jäder, 2022). This research, therefore, challenges the assumption that “any play” benefits cognition equally; instead, it shows that the cultural and interactive quality of play is a decisive factor in shaping creativity and numeracy outcomes.

Qualitative evidence deepens this interpretation. Teachers and parents in Aceh consistently described how children’s engagement with traditional games fostered broader imagination and a more contextual understanding of numeracy. This supports recent studies on critical and creative thinking in primary education, which show that interactive and culturally grounded learning contexts are more effective at developing problem-solving skills than abstract instruction (Krisztián et al., 2015; Pawartani et al., 2024). The study also highlights the role of individual differences—such as Adversity Quotient categories of quitter, camper, and climber (Cahyati et al., 2024; Weinstein & Bearison, 1985)—in moderating how children benefit from numeracy-based play (Taufiqurohman et al., 2022). These findings suggest that culturally rooted games transmit mathematical concepts and provide a stage for children to develop resilience, creativity, and strategic thinking simultaneously.

Another important implication is the affective dimension of learning. The negative coefficients associated with digital play mirror findings from research on mathematics anxiety, which show that certain learning environments can undermine confidence and performance (Zanabazar et al., 2023; Rico-González et al., 2023). This study’s digital game-structured, reward-centred format appears to limit the critical open-ended exploration for both creative and mathematical discourse. By contrast, traditional games’ tactile and social nature buffer against anxiety and promote a positive disposition toward problem-solving. This insight contributes to international debates on how early learning environments shape cognitive outcomes and attitudes toward mathematics and creative tasks.

These findings also have theoretical significance for integrating Islamic values and local wisdom into mathematics education. Previous studies have shown that embedding Islamic values in teaching materials—such as comics



or contextualised physics content – enhances student engagement and ethical understanding (Putri et al., 2022; Nurwati et al., 2024). The present research extends this line of inquiry by demonstrating that traditional games can function as vehicles for integrating cultural and religious values with mathematical concepts, thereby producing a holistic learning experience (Gal et al., 2020; Grotlüschen et al., 2020). This strengthens the argument for culturally responsive pedagogy as a means of uniting cognitive, affective, and moral development in primary education.

From a policy perspective, the findings underscore the need to move beyond generic play-based recommendations toward differentiated strategies that recognise the distinct effects of traditional, modern non-digital, and digital games (Happy et al., 2020). The high predictive value of play frequency across creativity and numeracy outcomes suggests that schools and communities should provide regular, structured opportunities for children to engage in culturally rich, hands-on play (Louw & Claassens, 2024). This aligns with international frameworks such as India’s NEP 2020 and UNESCO’s Sustainable Development Goals, which advocate experiential and inclusive learning from the early years (Chapman & O’Gorman, 2022; Grotlüschen et al., 2020). By situating its analysis within Aceh, the study offers a case that can inform cross-cultural education policies worldwide, illustrating how local traditions can be mobilised to achieve global objectives in foundational skills development.

At the classroom level, teachers can use traditional games as contextual teaching strategies to concretise abstract mathematical ideas and foster collaborative problem-solving. Studies on STEAM education in madrasahs show that integrating creative, hands-on activities enhances students’ collaboration and innovation (Zaqiah et al., 2024). Similarly, critical thinking research indicates that such contextualised approaches strengthen higher-order cognitive skills (Sasmita et al., 2023). However, teacher training and curriculum support are crucial to realize this potential. Teachers may need guidance on adapting traditional games to different mathematical topics and balancing these activities with curricular demands. This calls for sustained professional development and policy support rather than ad hoc initiatives.

The study also highlights the broader relevance of play for digital literacy and science process skills. Research has shown that digital activities can limit students' active exploration without careful design, but when integrated thoughtfully, they can complement hands-on learning and expand competencies (Astalini et al., 2024). Therefore, the goal is not to demonise digital play but to manage it strategically, integrating educational digital games that promote creativity and numeracy alongside traditional activities (Elmey et al., 2025; Rozi et al., 2025). This balanced approach can mitigate the negative effects of excessive digital exposure while leveraging its potential benefits (Darmaji et al., 2022).

Internationally, the Aceh case provides an instructive model for how culturally grounded play-based learning can contribute to cross-cultural discourse on early childhood education. By offering robust, context-sensitive evidence, this study enriches the global databank of research on play and learning, illustrating the potential of local practices to inform international best practices. This is particularly relevant in developing countries where traditional games risk being lost to digital technology; preserving and adapting these games for educational use can simultaneously enhance foundational skills and sustain cultural identity.

Finally, the study's limitations should be acknowledged as part of academic honesty. Because the quantitative component relies on parent self-reports, issues of recall and social desirability bias may affect the accuracy of reported play frequency and type. The cross-sectional design also limits causal inference; longitudinal or quasi-experimental research is needed to examine mechanisms over time and in classroom settings. Moreover, while the study accounts for socioeconomic and parental supervision factors, other variables such as gender dynamics in play or teacher attitudes toward traditional games merit deeper exploration. Recognising these limitations not only frames the scope of the present findings but also signals avenues for future research to refine and extend the proposed framework.



D. Conclusion

This study confirms that both the frequency and type of children's play are critical determinants of cognitive growth. Play activities are strongly associated with the development of creativity and numeracy, demonstrating that play should be understood as leisure and an essential element of learning. Moreover, the analysis reveals a differential effect: traditional games tend to make a positive contribution. In contrast, digital games show a negative tendency, underscoring the need to distinguish between types of play when evaluating their impact on children's cognitive outcomes.

By employing an Aceh-based case study, this research advances the literature on socio-cultural learning and embodied cognition by blending quantitative data from education reports with qualitative accounts from teachers and artisans. It deepens the understanding of the culturally embedded nature of play and its potential to support numeracy, thereby providing context-specific data and a cross-cultural comparative analytic framework. Theoretically, the findings strengthen cognitive development and contextual learning perspectives by demonstrating how culturally grounded play enhances children's numeracy and creativity (Nabilah et al., 2023). Practically, they offer a foundation for developing culturally relevant, locally grounded curricula that integrate play and learning approaches rooted in cultural heritage, extending insights from previous work on culturally responsive pedagogy and Islamic values integration.

Acknowledging its limitations, reliance on parent self-reports, recall, social desirability bias, and the cross-sectional design, this study highlights the need for longitudinal or quasi-experimental approaches in mathematics classrooms to examine causal mechanisms. Future research should explore how conventional and digital games can be systematically incorporated into formal teaching, assess their effects over time, and compare their influence across diverse socio-cultural contexts. Such investigations will clarify the mechanisms linking play to cognitive outcomes and contribute to policy development at both local and international levels on early childhood education.



By situating its findings within cognitive development theory, contextual learning, and the integration of local values, this study advances theoretical understanding and offers practical strategies for educators and policymakers. It demonstrates that traditional games provide a uniquely effective and culturally resonant pathway for children's creativity and numeracy development. It also illustrates how a local case can inform international debates on early childhood education. The study underscores the urgency and potential of culturally responsive, play-based learning as a strategic approach to fostering foundational skills and revitalizing cultural heritage in the digital era.

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