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Interactive Math Learning Using Chopsticks in Early Childhood Education

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Abstract
This study explores the impact of the use chopsticks in learning math interactively towards the development of fine motor skills among kindergarten learners in East Java Indonesia. Focusing on the use of chopsticks, this study was using a qualitative research design of case study. The study involved classroom observation and semi-structured interviews to gather insight into teacher-child interactions. The sample includes four and five-years-old children and their teacher., selected through purposive sampling. The findings emphasize that math learning using chopsticks assist teacher to recognize students' prior knowledge. This promotes new learning model to support their concentration by linking new ideas to prior knowledge.

Keywords: Chopsticks, Math Learning, Early Childhood**.**

1. INTRODUCTION

Early childhood is a critical period in human development, often referred to as the "golden age" due to the rapid growth and development across various domains such as physical, cognitive, social, emotional, and moral aspects. This stage lays the foundation for future learning and character formation, making it essential to provide appropriate stimuli and environments for optimal development. The rapid development in motoric, language, cognitive, social, emotional, and moral domains during early childhood necessitates careful guidance to ensure all potential is realized (Al Munawaroh et al., 2023). While the focus on structured learning is beneficial, some argue that overly formalized approaches may hinder creativity and play-based learning, which are also vital for holistic development in early childhood. Creativity and play-based learning are integral to holistic development in early childhood, as they foster cognitive, social, and emotional growth. These approaches allow children to explore their environment, express themselves, and develop critical thinking skills. Play-based learning, in particular, is a dynamic process that supports various developmental domains, including physical, cognitive, and socio-emotional aspects. This approach aligns with the United Nations

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Sustainable Development Goals, emphasizing quality and inclusive early childhood education (Wright et al., 2023).

According to some studies conducted by scholars as Ida (Ida et al., 2023), she conducted a study on fifth-grade students demonstrated that higher concentration levels significantly improve mathematics learning outcomes. The research found that concentration contributed to 48.2% of the variance in students' math performance, highlighting its importance in academic success. Acuna (Acuña et al., 2022) finds out that chopsticks' usage has been shown to increase brain activation in the prefrontal cortex, which is crucial for fine motor skills and cognitive functions. This is evidenced by a 36% greater increase in oxyhemoglobin levels in the prefrontal cortex when using chopsticks compared to using hands, although no significant difference was found compared to fork use. Another study by Kim (Kim et al., 2020) explained that in populations unfamiliar with chopsticks, such as those with parkinsonian disorders, chopstick skills can be impaired, indicating that proficiency and cultural familiarity are significant factors in their effectiveness as a developmental tool. A study which was reported by Baid (Baid et al., 2022), stated that an overall increase of 30.40% in students' mathematics learning outcomes from the first to the second cycle. This substantial improvement suggests that the Talking Stick learning model effectively enhances student engagement and understanding in mathematics. While according to Ong & Kwata (Ong & Kawata, 2016), it is said that a study on the arithmetic-based game "Chopsticks" demonstrated that engaging with chopsticks in a structured game format improved the arithmetical competencies of young children. Participants in the experimental group showed enhanced problem-solving abilities and efficiency in arithmetic tasks compared to a control group.

Moreover, as the effectiveness of these methods can vary based on local practices and stakeholder engagement. The main problems in developing creativity and play-based learning especially in math learning primarily due to traditional teaching methods and systemic educational constraints. These challenges hinder the integration of creative and playful approaches that could enhance students' engagement and problem-solving skills. While play-based learning and games can enhance creative problem-solving, their integration into the curriculum is often limited by traditional pedagogical approaches and a lack of teacher training in these methods (Untarti & Ainun Najib, 2021). Hence, teachers need to be intentional and knowledgeable about incorporating play into mathematics instruction to foster a joyful and engaging learning environment because Playful activities, such as games and challenges, increase student interest and facilitate the understanding of abstract concepts.

There is a difference between the use of creativity and play-based learning and classical learning. Creativity-based and classical learning approaches differ significantly in their impact on cognitive and fine motor development, as well as academic achievement. Creativity-based learning emphasizes the development of original thinking and problem-solving skills, which are crucial for cognitive growth and academic success. In contrast, classical learning often focuses on rote memorization and the acquisition of pre-determined knowledge. Pavlenko (Pavlenko, 2020) describes creativity-based approaches, such as project-based learning, often involve hands-on activities that can improve fine motor skills. These activities require students to manipulate materials and tools, thereby enhancing their motor coordination while classical learning typically involves less physical interaction, focusing more on written and verbal tasks, which may not contribute as significantly to fine motor development.

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The preliminary observation, Minister of Primary and Secondary Education (Mendikdasmen) Abdul Mu'ti had mentioned that he would initiate the Deep Learning Curriculum as a substitute for the Merdeka Belajar Curriculum currently implemented. Mu'ti stated the Deep Learning Curriculum as a replacement for the Merdeka Belajar Curriculum in an activity. According to Mu'ti, deep learning aims to provide a more meaningful and enjoyable learning experience for students. Deep learning has three main elements, namely Mindful Learning, Meaningful Learning, and Joyful Learning. Mindful learning means recognizing students' different circumstances, while meaningful learning means encouraging students to think and engage in the learning process. And, joyful learning means promoting satisfaction and deep understanding. However, one of Islamic Kindergarten in East Java found that the policy is line with the condition of their learners at that time, where their learners are various and need different approaches to optimize their complex development.

In addition, to prepare further activities on the play-based learning, learners can be asked to do activities that stimulate their curiosity, creativity, and cognitive skills. f course, the success of play-based learning in math depends on interactive tools which can enhance engagement and understanding. It also depends on the use of manipulatives and visual aids supports diverse learning styles and helps in developing concrete, representational, and abstract reasoning skills. Accordingly, this research addresses an investigation on the use of chopsticks for developing the basic math skills in early childhood at the Islamic Kindergarten.

2. LITERATURE REVIEW

The Importance of Basic Math Learning

The development of basic math skills in early childhood is crucial for later academic success and life outcomes. These skills can be fostered through structured learning environments and innovative teaching methods. Children develop counting skills and an understanding of cardinality, which is the concept that numbers represent quantities. Initially, children learn the cardinalities of small numbers and gradually understand how counting represents these cardinalities. Children first learn the cardinalities of numbers one to four before fully grasping how counting tracks cardinality for all numbers. This early understanding includes recognizing that the last number in a count represents the set's cardinality, known as the cardinal principle. Studies indicate that children develop set-to-word mapping (how-many task) before word-to-set mapping (give-n task), suggesting that understanding cardinality begins with recognizing quantities before being able to create them. It also indicates that foundational skills such as counting, understanding cardinality, and recognizing numerical patterns are essential during the toddler and preschool years. Studies show that structured quantities enhance this understanding, allowing children to grasp numerical concepts more efficiently (Baroody et al., 2023).

Early childhood is a critical period for developing mathematical skills. Teaching interventions during this time can significantly enhance children's mathematical understanding and development. Foundational number sense, the ability to discriminate among quantities, is predictive of later academic and professional success. Deficits in this area can lead to lifelong challenges in mathematics. Early exposure to math concepts enhances children's ability to process numerical information, which is essential for their overall educational trajectory (Björklund et al., 2020). The importance of basic math learning is multifaceted, impacting both cognitive development and practical life skills.

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Mathematics education is crucial for developing logical, rational, and critical thinking, which are essential for problem-solving and decision-making in everyday life. Furthermore, it plays a significant role in character building, fostering values such as discipline, honesty, and responsibility. In that case, understanding and accommodating different learning styles, such as visual, auditory, and kinesthetic, can enhance students' mathematical literacy and their ability to apply math skills in real-life situations (Hanur, 2019).

The Importance of Fine Motor Skills Development

The literature indicates that appropriate stimulation of fine motor skills is crucial for optimal development in early childhood. It emphasizes that engaging children in activities that promote fine motor skills can lead to significant improvements in their cognitive abilities, social interactions, and emotional well-being. Fine motor development is not just a standalone skill but is interconnected with various developmental domains. By providing the right stimulation, children can achieve better outcomes in their overall development, making it a critical area of focus for caregivers and educators alike (Aura Maharani et al., 2024). Educators should design and implement activities that require precision and control, such as arts and crafts, building blocks, and other hands-on tasks. This approach can enhance children's fine motor skills while keeping them motivated and interested in learning. Besides individualized instruction tailored to each child's needs can significantly support fine motor skills development. Teachers should assess each child's abilities and provide targeted support and challenges to help them progress at their own pace. This personalized approach can lead to better outcomes in skill development (Nik Roseli et al., 2024).

The survey emphasizes that fine motor skills are crucial for early childhood development, particularly for coordinating eye and hand movements. This foundational skill set is essential for various daily activities and learning processes in young children. Furthermore, motivation, lesson planning, and the learning environment also significantly affect the improvement of fine motor skills in young children. This comprehensive understanding can guide future educational practices and interventions. Motivation, lesson planning, and the learning environment also significantly affect the improvement of fine motor skills in young children. This comprehensive understanding can guide future educational practices and interventions (Isnaini & Katoningsih, 2022).

The Use of Chopsticks

The use of chopsticks in educational settings can serve as a gateway to enhancing children's cognitive abilities through playful learning. By engaging in activities that require precision and coordination, such as picking up small objects or sorting items by size and color, children not only refine their fine motor skills but also develop foundational mathematical concepts like counting and categorization. This hands-on approach aligns with qualitative research findings that emphasize the importance of interactive learning environments for young learners, suggesting that integrating tools like chopsticks can significantly enrich the educational experience (Sutini & Rahmawati, 2018).

Additionally, incorporating such tactile methods may foster greater enthusiasm for mathematics, making it more accessible and enjoyable for early childhood education (Rozie & Haryani, 2021). This enthusiasm can lead to increased participation and motivation, ultimately resulting in a deeper understanding of mathematical principles as

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children discover the joy of learning through play. This playful engagement not only enhances cognitive development but also encourages social interactions among peers, fostering collaboration and communication skills essential for their overall growth. Such collaborative experiences can lay the groundwork for lifelong learning habits, as children learn to value teamwork and shared problem-solving while navigating mathematical concepts in a fun and engaging manner. Such collaborative experiences can lay the groundwork for lifelong learning habits, as children learn to value teamwork and shared problem-solving while navigating mathematical concepts in a fun and engaging manner.

Furthermore, the integration of chopsticks in early childhood education not only enhances mathematical understanding but also promotes cultural awareness and appreciation among young learners. By introducing children to traditional practices associated with using chopsticks, educators can cultivate a sense of global citizenship while simultaneously enriching their sensory experiences. This cultural dimension is particularly significant in diverse classrooms where exposure to various customs fosters inclusivity and empathy, essential traits for social development. Additionally, research indicates that such culturally responsive teaching methods contribute positively to children's engagement and motivation, as they see the relevance of learning tools within broader societal contexts. Consequently, this multifaceted approach empowers children to connect mathematical concepts with real-world applications, thereby reinforcing their cognitive and social skills in a holistic manner (Meylani, 2024).

3. METHODS

This study is designed to solve the classroom problem dealing with the development of fine motor skills and the use of chopstick as a tool in learning math. This research employs qualitative research in early childhood mathematics education focuses on understanding how young children learn mathematical concepts through play, interaction, and exploration within their environments and to enhance cognitive abilities and fine motor skills through various interactive and hands-on learning experiences. The case study approach in mathematics education involves several key steps designed to enhance cognitive abilities and fine motor skills. These steps include identifying a relevant mathematical problem, gathering data through observation and interaction, analyzing the findings to draw connections between theory and practice, and finally implementing solutions while encouraging hands-on engagement with mathematical concepts (Creswell, 2014).

Identifying a relevant problem involves narrowing down a broad phenomenon to a specific question that can guide inquiry and data collection. including reviewing existing literature to ensure the problem is well-defined and contributes to the field's body of knowledge. Gathering data through observation and interaction means observing classroom interactions can provide insights into learning and teaching dynamics. Combining observation with interactive research methods, such as involving stakeholders in planning and executing observations, can enhance the validity and acceptance of findings. Analyzing findings means bridging between theoretical understanding and practical application.

The researcher used chopsticks as implementing solution towards the problem discussed previously. This research posits a play-based learning that is purposively chosen to acquire fine motor skills. This innovative approach hopefully not only captivates children's interest but also encourages them to explore and experiment, which are essential components of effective learning in their formative years.

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4. RESULTS

In this research, the learners were asked to practice a game that introduces basic math for early childhood by using chopsticks and beads. The introduction of math chopsticks directly invited children to practice it. Math chopsticks used food chopsticks, colorful beads, and also various shapes. Beads were red, yellow, blue, green, and white. For the shape of the beads chosen had four shapes square, oval, round, and tube. the tools used were not only chopsticks and beads, there were cups, paper and markers. There were five steps of activities which the researcher has been explored. The practice of math pipping required five children in each activity, the first activity was pipping the beads according to color, the second was pipping the beads according to shape, the third was pipping the beads according to quantity, the fourth was pipping according to color and quantity, and the fifth was pipping the beads according to shape and quantity. From the first activity of pipping the beads according to color, the five children could distinguish red, yellow, green, blue, and white. However, they also had difficulty with pipping at the beginning because they were not used to it. Children did not lack ideas, there were also children who pipped using the help of both hands.

Figure 1. Pipped using the help of both hands (photo by: Novitasari)

For the second activity, pipping according to shape. At the beginning, those five children had difficulty distinguishing round, tube and oval shapes, because round and oval shapes are almost the same at a glance. In this second activity, children have difficulty when pipping round beads. The third activity was pipping according to the number, in this third activity required patience and accuracy, because they were not used to hold on the chopsticks properly. When they can hold on the chopsticks, children rushed to put them in the glass without paying attention to the numbers that have been written on the glass. Of the five children, there were two children who were less careful and impatient so they could not complete the activity until the end. The fourth activity was pipping according to color and number. In the fourth activity, the five children were agile in pipping to recognize the color. They were more dexterous in putting the beads into the glass, although there were still children who used two hands. The fifth activity was pipping according to shape and number, this last activity was done by children who have finished the first and second activities. The teacher chose children who were careful and patient, so that this fifth activity could be completed until the end.

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Figure 2. The last activity of the use of chopsticks for math learning (photo by: Novitasari)

The activity of math chopsticks does train accuracy and patience in early childhood, especially ages 4-5, in this activity muscle strength and concentration also affect. Math chopsticks is an effective educational game to develop fine motor skills while introducing basic math concepts. Through the activity of moving, grouping, counting children can coordinate between hands and eyes. In addition, this game also improves children's concentration and problem-solving skills in a fun and interactive way. Below is the result of those five activities:

Table 1: Result of interactive math learning using chopsticks.

No	Name	Age	pipping the beads according to color	pipping the beads according to shape,	pipping the beads according to quantity	pipping according to color and quantity	pipping the beads according to shape and quantity
1.	Em (F)	4	✓	✓	✓	✓	✓
2.	FF(F)	5	✓	✓	✓	X	X
3.	Fh(M)	5	✓	✓	X	X	X
4	Th(M)	4	✓	✓	X	X	X
5.	Rs(M)	4	✓	X	X	X	X

From those activity, one student could finish all of the activities equally. The second student only accomplish three activities. She still got difficulties in pipping using one hands, mainly start from the fourth and the fifth activities. The third student and the fourth student only accomplish two activities. They still have difficulty finding numbers and need help from the teacher and take a long time to determine the beads. The fifth student accomplish one activity. It was because he got difficulty distinguishing between round and oval shapes, and takes a long time. The research finding exemplify that the use of chopsticks for math learning practiced has its own value for children's achievement. the use of chopsticks for math learning game focuses more on fine motor achievement. This activity trains hand-eye skills and finger muscle strength when holding chopsticks, controlling, and moving objects appropriately. This activity also involves the achievement of cognitive aspects, in this activity contains planning and concentration, but this activity mainly refers to fine motor achievement.

Based on the findings, although the method highlights the importance of interactive learning, it is also essential to consider that not all children may respond equally to these activities. Individual differences in learning styles and preferences can influence the effectiveness of fine motor skill development strategies. This is because in early

childhood education, there are various developmental values and achievements that will be achieved by children, such as cognitive, language, fine motor, gross motor. Thus, early childhood education (PAUD) has a very important role for the growth and development of children, in early childhood children will feel great curiosity.

5. DISCUSSION

The interesting of math learning by the use of chopsticks is intriguing due to their ability to engage students in a hands-on, interactive manner that enhances cognitive and motor skills. As shown by those five students, this approach not only makes learning more enjoyable but also aids in the development of mathematical thinking and problem-solving abilities. Because by allowing students to engage with math through a novel and culturally relevant tool like chopsticks, educators can foster a sense of competence and autonomy, which are crucial for maintaining student interest (Baten et al., 2020). The use of chopsticks, particularly designed for learning, can enhance cognitive and motor skills, especially in children. These specialized chopsticks are engineered to facilitate the correct positioning and movement of fingers, which can improve dexterity and coordination. The structured design of these chopsticks aids in developing fine motor skills and cognitive abilities by engaging multiple fingers in a coordinated manner. This engagement is crucial for children as it supports the development of hand-eye coordination and spatial awareness.

The use of hand movements, such as those required for chopstick manipulation, has been shown to improve cognitive abilities in early childhood, including memory and the ability to recognize numbers and sequences. This indicates that the physical act of using chopsticks may also contribute to cognitive development through the enhancement of memory and learning skills (Marliana et al., 2021). From the Table 1 above, we can consider that the structured use of chopsticks can also stimulate cognitive development by requiring the child to focus on the task, improving concentration and problem-solving skills as they learn to manipulate the chopsticks effectively. The learners' concentration in the process of math learning is a critical factor influencing their academic performance. Concentration levels can significantly impact students' ability to understand and retain mathematical concepts. As explained in Table 1 above, it has been shown that math learning using chopsticks assist teacher to recognize students' prior knowledge. This promotes new learning model to support their concentration by linking new ideas to prior knowledge (Rochani, 2019).

Furthermore, concentration is a pivotal factor in math learning, it is also essential to consider the broader educational context. Factors such as teaching methods, curriculum design, and student motivation play significant roles in shaping concentration and engagement. Features like cartoon picture sticking blocks make the chopsticks more engaging for children, encouraging consistent use and practice (Oktaviani & Setiyono, 2023). Franchin (Franchin, 2011) said that activities involving the assembly of toys also promote the development of cognitive and manual skills, highlighting the importance of manipulative tasks in childhood development. the use of chopsticks is culturally specific, the underlying principle of using tools to enhance cognitive and motor skills is not universally applicable. The use of chopsticks as a learning tool in populations unfamiliar with them, particularly in the context of learning mathematics, can be an innovative approach.

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6. CONCLUSION

Based on the result of the research, the researcher concludes that learning math using chopsticks for early childhood is suggested to enhance cognitive development in young children, providing them with a fun and engaging way to improve their dexterity and coordination. The findings suggest that integrating such playful methods into early childhood education can lead to significant improvements in both physical and mental capabilities, fostering a more holistic approach to learning. By utilizing chopsticks as a tool for play-based learning, educators can create an interactive environment that promotes not only skill development but also social interaction among peers, further enriching the educational experience. Such activities can also help in building patience and concentration, as children learn to control their movements and focus on tasks that require precision. These foundational skills can translate into greater academic success and a lifelong love of learning, as children become more confident in their abilities to tackle challenges both inside and outside the classroom.

Incorporating chopsticks into math activities not only makes learning fun but also encourages students to develop patience and precision as they manipulate small objects, fostering a deeper understanding of numerical relationships. This hands-on approach can transform abstract concepts into tangible experiences, allowing students to visualize and physically interact with numbers in a way that traditional methods may not achieve. By creating games and challenges that involve using chopsticks, educators can further motivate students to practice their math skills while enjoying the process, ultimately leading to improved retention and application of mathematical principles in real-life situations. Through these engaging activities, students can enhance their fine motor skills while simultaneously building confidence in their mathematical abilities. Further research is allowed mainly in populations unfamiliar with the use of chopsticks as a interactive learning tools.

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