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Enhancing Early Childhood Numeracy: The Impact of Abacus Activities at the Bali Abacus House Guidance Institute

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ABSTRACT

This study explores the implementation, opportunities, challenges, and influencing factors of numeracy skill development in children aged 5–6 years through abacus activities at the Bali Abacus House tutoring institution. A qualitative case study approach was used, involving 15 children, parents, and teachers over six months. Data were collected through observations, interviews, and document analysis. Triangulation techniques ensured accuracy and validity by cross-verifying information from multiple sources. Findings indicate that abacus activities provide a strong foundation for counting and mathematical concept development. Opportunities include improved arithmetic understanding, while challenges involve the need for trained instructors and children's transition from concrete to abstract mathematical thinking. The success of abacus learning is influenced by developmentally appropriate teaching methods, such as Montessori-based individualized learning. However, integrating abacus activities into different educational settings presents challenges, particularly with the increasing emphasis on digital literacy in modern curricula. Balancing hands-on learning with digital tools is crucial to maintaining engagement and effectiveness. Incorporating abacus activities into early childhood education can enhance cognitive processing and numeracy skills. A blended approach that integrates abacus-based learning with digital resources may optimize outcomes. Future research should examine the long-term impact of abacus training on mathematical proficiency and explore strategies for its integration into diverse educational models.

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1. INTRODUCTION

Learning to count in early childhood is a basic concept that is the foundation for mathematical development. Introduction to counting at an early age is essential because it not only improves numeracy skills but also encourages cognitive growth and problem-solving abilities (Onoshakpokaiye, 2023; Widiastuti & Kirono, 2022). However, there have been criticisms regarding the methods used in early childhood education, with concerns raised about the lack of emphasis on basic mathematical concepts and the need for more engaging and effective teaching strategies (Mar'ah, Karima, Shakira, Kinasih, & Hasanah, 2022; Hidayat, Herniawati, & Ihsanda, 2022).

Early numeracy is a crucial component of early childhood education, forming the foundation for children's mathematical understanding and problem-solving skills in later life. Despite the recognized importance of early numeracy development, there remains a gap in effective and engaging teaching strategies that cater to young children, especially in using tactile learning tools. Traditional methods often struggle to capture children's attention and provide them with a concrete understanding of abstract concepts. The abacus, an ancient yet powerful learning tool, offers a unique approach by allowing children to physically manipulate beads, helping them grasp basic mathematical principles through hands-on experience. The abacus not only engages children in active learning but also aids in strengthening their cognitive and fine motor skills, making it an ideal tool for early numeracy development.

Numeracy skills in early childhood play a crucial role in predicting academic success later in life. Early numeracy skills include a variety of abilities, such as counting, comparing quantities, recognizing number symbols, and estimating quantities (Lopez-Pedersen et al., 2022). These basic skills are essential for developing higher-order thinking skills, such as critical thinking and problem-solving (Marhami et al., 2023). Research has shown that early numeracy skills not only predict numeracy proficiency later in life but also affect literacy skills (Novita et al., 2023). Therefore, fostering numeracy skills in early childhood is essential for overall cognitive development. However, many children face challenges in developing numeracy skills. Factors such as service quality, household environment, and community factors can have a significant impact on the development of numeracy skills in early childhood (Hossain et al., 2022). Parents play an important role in supporting children's numeracy development by carrying out activities that stimulate their thinking power (Lestari et al., 2022). In addition, the learning environment at home, including activities such as counting, can significantly affect children's numeracy competencies (Soto-Calvo et al., 2020).

Counting in early childhood requires complex skills that involve sequencing numbers in the correct order, assigning each item in a set of numbers and counting each object (Kesicioğlu, 2021). At the age of 5-6 years, children begin to understand that numbers represent quantities and can be used to calculate objects, actions, or events (Rahayu et al., 2023). They usually learn to pronounce numbers sequentially and begin to understand the concept of one-to-one correspondence, associating each object with a single word number (Sari et al., 2020). Children at this age also develop basic skills of addition and subtraction, using numeracy strategies to solve simple mathematical problems (Kullberg et al., 2020). In addition, they began to explore concepts such as ordinal numbers (first, second, third) and the relative size of a number (more, less) as much as possible (Sidik et al., 2021).

Realizing the importance of the numeracy development stage and as an optimization of services and the achievement of educational goals, the tutoring institution Rumah Abpoa Tegalwangi Denpasar implements innovative strategies to improve numeracy skills effectively through the use of abacus as a tool to teach numeracy concepts to children aged 5-6 years. Abacus is effective in teaching arithmetic to ananks because of its concrete and visual nature. To help children better understand numbers, it is recommended that children learn to count real or concrete objects, which shape their experience (Baroody, 2017). The physical beads on the abacus provide a concrete representation of numbers, allowing children to see and manipulate quantities directly which can help develop a solid foundational understanding of the principles of counting. Practical activities, games, and concrete aids engage many senses and facilitate a deeper understanding of numerical relationships in children (Kesicioğlu, 2021). By providing a real, visual representation of numerical concepts, abacus can help improve children's understanding of mathematical operations and problem-solving. Abacus encourages children to explore different counting strategies and develop problem-solving skills as they experiment with different ways of manipulating beads to find the correct answer (León et al., 2021).

Teaching the concept of arithmetic using abacus to children aged 5-6 years is certainly not an easy thing for teachers, as well as for children. One of the obstacles and challenges lies in the early adaptation period, where students may find it difficult to understand the correlation between the physical manipulation of beads in the abacus and abstract numerical concepts (Watanabe, 2021).

Additionally, students have difficulty coordinating their movements to accurately represent the numbers on the abacus, especially if they have limited fine motor skills (Hao, 2018). Another challenge is to maintain the child's focus and attention during abacus-based counting activities, as the novelty of this tool may distract some students (Jesus et al., 2022). In addition, students also have difficulty in transitioning from concrete representations on the abacus to abstract mental calculations, so the child needs support from a mentor or teacher.

Numerous studies have explored the impact of abacus activities on enhancing arithmetic skills in early childhood. Syifa and Simatupang (2020) found that using an abacus can significantly develop numeracy skills in kindergarten B children aged 5–6 years. Similarly, Ray et al. (2023) discovered that students proficient in abacus use perform calculations more quickly and accurately compared to their peers who do not use the tool. Ahmad (2021) also reported that incorporating the abacus into learning markedly improves calculation speed and enhances the accuracy of answers.

This study seeks to address the gap in engaging numeracy strategies by exploring the implementation of abacus activities in early childhood education. Specifically, it aims to investigate three key aspects: 1) the ways in which abacus activities are implemented in early learning settings, 2) the opportunities and challenges encountered during these activities, and 3) the impact of these activities on children's numeracy skills. By introducing the abacus as a potential solution to the challenges in early numeracy education, this research highlights its benefits as a tactile learning tool that fosters a deeper understanding of mathematical concepts. Given these challenges, this study proposes abacus activities as a practical and effective strategy to support early numeracy development, offering insights into its potential integration into early childhood education curricula.

2. METHODS

This study employs a qualitative approach with a case study method, focusing on abacus activities at the Tegalwangi Denpasar Abacuss House to gain a comprehensive understanding of how these activities influence the numeracy skills of children aged 5-6 years. The "case" in this context is defined as the specific implementation of abacus activities within one class of the institution, providing an in-depth look at the processes, opportunities, and challenges that arise in a single educational setting. The Tegalwangi Denpasar Abacus House, known for its early childhood education programs, emphasizes hands-on learning approaches, and has a history of integrating various learning tools, including the abacus, into its curriculum. This background offers a rich context for examining the effects of abacus activities on young learners' numeracy development.

The study employed a purposive sampling strategy to ensure a diverse representation of key stakeholders, including teachers who facilitate abacus activities, parents who observe their impact at home, students who participate in the sessions, and institution managers who oversee the program. A total of 10 participants were selected, comprising 3 teachers, 2 institution managers, 3 parents, and 2 students. Data collection spanned three months and utilized multiple methods: interviews with teachers, parents, and students to gather personal insights; direct observations of abacus sessions to capture real-time interactions and learning processes; and document analysis of lesson plans, student progress records, and other relevant materials. The data were analyzed using qualitative descriptive techniques, which involved coding responses, identifying recurring themes, and employing triangulation to cross-verify findings from interviews, observations, and documents. The research team, consisting of three experts in early childhood education, collaboratively conducted the analysis to maintain objectivity and consistency. Triangulation was achieved by comparing data from various sources, with discrepancies discussed and resolved to enhance the credibility and reliability of the findings (Husnaini et al., 2020; Bao, 2020).

3. FINDINGS AND DISCUSSION

3.1 Findings

The results of the study showed that children's numeracy skills increased through abacus play activities. It is proven that this activity can improve children's understanding of number concepts, adding skills, and problem-solving. The steps in the abacus play activity include: (1) the teacher provides mazes, puzzle questions, or story questions and abacus (modification), (2) the teacher introduces how to play maze, puzzle problems, or story problems and how to use abacus (modification), (3) the teacher gives an example of how to count using abacus (modification) from 1-10 then continues with 1-20 which the child, (4) follow after the child understands how to count using abacus (modification), They are given the task of solving mazes, puzzle problems, or story problems with the help of abacus (modification), and (5) the teacher monitors and encourages the children to be confident in completing their tasks. Before implementing the steps of the cooperative learning method, the researcher also prepared classroom arrangements and media in the form of abacus and pictures of fruits. According to Luo (2023), it is important to build a positive psychological atmosphere by combining the implementation of the curriculum with environmental planning to support active learning and child development (Luo, 2023).

In an enlightening interview, abacus teachers shared insights into the diverse reasons behind abacus activities, as follows:

> *"The abacus activity is designed to bridge the gap in traditional math education, offering an interesting and fun method for children to understand basic numerical concepts. We emphasize the scientific basis for choosing abacus, especially for children aged 5-6 years, and highlight the alignment of abacus with cognitive development theory. Abacus is taught to take advantage of children's natural inclination at an early age for visual and kinesthetic learning, facilitating a deeper understanding of arithmetic, arithmetic operations, and the base ten system through the physical manipulation of beads. This practical approach not only helps to instill numerical concepts more firmly in children's minds but also improves memory retention and attention to detail. Regarding the hope, we have optimism that this program will not only improve children's math skills but also instill a lifelong love of learning. Expected outcomes include improved problem-solving skills, improved mathematical intuition, and increased confidence that extends beyond the classroom, equipping students with a solid foundation for future academic endeavors and everyday life challenges".*

The results of interviews with parents regarding the context of learning needs and the environmental context of the abacus activity program to improve the numeracy skills of children aged 5-6 years have yielded in-depth results. Parents are well aware of the importance of developing numeracy skills early on, and emphasize that a strong foundation in mathematics is essential for their children's academic success and lifelong success. Many expressed interest in innovative and interesting learning methods, such as abacus, to spark their children's interest in mathematics from an early age. They noted that the tactile and visual aspects of abacus activities have the potential to make math more accessible and enjoyable for young learners, as opposed to traditional rote learning methods. The environmental context of the programme also emerged as an important consideration, with parents highlighting the need for a supportive and resourceful learning environment that not only develops academic skills but also social interaction and emotional well-being.

In the observation carried out by the researcher, during the learning activity, the teacher first gave the children an understanding of the steps to play abacus using simple language. Then, the teacher creates a fun and relaxed learning atmosphere by inserting songs that give encouragement, such as "Applause of Encouragement," in the middle of the lesson. Teachers also added games such as "smart kid shooting" to prevent boredom in children. This approach is in line with the opinion of Pan et al

(2022) that by combining fun and engaging activities, such as activities involving play and relaxation, children can develop their math skills holistically.

The research conducted on children's numeracy skills through abacus play activities has several advantages including helping children understand the concept of numbers more easily, training children's concentration, and children's fine motor skills, helping children count faster, children faster memorizing or remembering additions, making it easier for children to add which results are more than 10, but has several weaknesses, namely abacus only helps in the learning process, When children are quick to memorize and are able to use the shadow method, abacus will be quickly forgotten, the ability to count is only on the ability to add up which is no more than 20, abacus (modification) can only be used for children who learn to count for the beginning, abacus (modification) cannot be carried anywhere because the size of abacus is quite large compared to plastic abacus that can be put in a bag. In this study, what is more improved is the aspect of understanding the concept of numbers, this happens because the average child already understands that the number 5 is 5, then there are improvements made by the teacher when explaining how to play abacus with continuous repetition.

There is one weak aspect, namely the problem-solving aspect. This aspect is said to be weak because it can be seen that when the child finds the results, there are still things that are not filled in by the child, and the results are still wrong because the child is in a hurry. Some of the weaknesses of children's numeracy skills are influenced by several other weaknesses that occur in learning activities through abacus play activities such as: 1) There are still some children who are not focused and not serious when the teacher explains about the activities that the children are doing, 2) There are still children who are noisy in class, 3) Children still need more intensive teacher guidance.

The results of interviews and observations of the learning process found that the use of abacus in learning the concept of counting in children aged 5-6 years shows several advantages, such as helping children understand the concept of numbers more easily, training concentration and fine motor skills, accelerating numeracy skills, and making it easier for children to memorize or remember addition. In addition, abacus makes it easier for children to add up which results in more than 10. However, there are some drawbacks, including abacus only helping during the learning process. If the child memorizes quickly and uses the shadow method, the abacus will be quickly forgotten. The trained numeracy skills are limited to summing up to 20, and abacus (modification) is only suitable for children who are just learning to count. In addition, the large size of the abacus (modification) makes it impractical to carry around compared to a plastic abacus that can be put in a bag. In this study, the most improved aspect is the understanding of the concept of numbers, because the average child already understands that the number 5 means that the number is 5. This is supported by the improvement made by the teacher in explaining how to play abacus through continuous repetition.

Interviews with parents regarding the effectiveness and efficiency of abacus activities in improving the ability of counting concepts in children aged 5-6 years resulted in positive responses, as well as in-depth perspectives on the opportunities and challenges posed by this educational approach. A plethora of parents report significant improvements in their children's understanding of numbers and arithmetic operations, and attribute this progress to tactile and visual learning experiences facilitated by abacus. Many praised this method for its efficiency in making complex mathematical concepts more accessible and engaging for children, and highlighted the opportunities it provides children to develop a love and fundamental understanding of mathematics from an early age.

Abacus activities for children aged 5-6 years are carried out with a Montessori approach that emphasizes independent activities, direct learning, and collaborative play. In this setting, children are introduced to abacus in an environment that is ready to encourage exploration and discovery. The environment is carefully structured with materials that meet the child's learning needs, including child-sized abacus and other related Montessori materials that visually and tactilely represent mathematical concepts. The goal is to arouse curiosity and facilitate the natural desire to engage with numbers and mathematical operations. Initially, educators present abacus to children in a simple and easy-to-understand way, demonstrating its basic uses and inviting children to explore the beads and their rows.

This direct interaction is very important because it helps the child develop a tactile understanding of numbers and their relationships. Children are encouraged to manipulate beads to represent different numbers, gradually moving on to performing simple arithmetic operations such as addition and subtraction. Through self-discovery and minimal guidance from educators, children learn to solve math problems at their own pace, fostering independence and a sense of accomplishment. The Montessori approach values each child's individual learning journey, ensuring that they not only learn to use abacus but also build foundational skills in concentration, coordination, and problem-solving. This method of learning through hands-on experience with the material fosters a deep understanding of mathematical concepts and a lasting interest in learning.

Weaknesses in abacus activity were found in children aged 5-6 years. Abacus is only effective during the learning process. If children are quick to memorize and use the shadow method, they tend to forget abacus quickly. The abacus-trained numeracy is usually limited to adding up to the number 20, making it less effective for more complex mathematical operations. Additionally, abacus (modified) are usually quite large, making them less practical to carry around compared to smaller plastic abacus. Finally, abacus (modification) is more suitable for children who are just starting to learn to count, and may be less effective for children who already have a better understanding of basic mathematics. Some children are also weak in their problem-solving skills. Some weaknesses appear when the results are incomplete or wrong because the child lacks patience when doing assignments. This inability is influenced by other negligence in abacus activities, including the lack of concentration of some children during the teacher's explanations, the noise in the classroom, and the child's need for more intensive guidance from the teacher.

Learning abacus offers a significant opportunity to improve numeracy skills in children aged 5-6 years, as it provides a real and visual method for understanding basic arithmetic concepts, fosters a strong foundation in the sense of numbers, and improves mental numeracy skills. The practical nature of abacus can make learning more engaging and interactive, meeting children's developmental needs for real-world experiences. However, the challenges include the need for trained instructors who are proficient in abacus techniques, the potential difficulties for some children in the transition from physical abacus thinking to abstract mathematical thinking, and the need to integrate abacus activities with broader curricular goals to guarantee a comprehensive mathematics education.

In an effort to overcome problems and weaknesses in abacus activities, teachers create learning and assessment experiences with attractive illustrations and colors so as to create an alluring learning environment for children. With the use of clear images and bright colors, children can more easily understand the mathematical concepts taught through abacus. Illustrations and colors add a visual dimension to learning, spark children's interest, and help strengthen the connection between abstract information and applicable reality. This approach not only makes it easier for children to understand the mathematical concepts they face, but also ensures that the learning process becomes colorful, interesting, and memorable for their cognitive development.

The researcher collected secondary data on student learning outcomes before and after participating in the abacus method program. The results showed that there was a significant increase in outcomes in each individual. The increase can be seen in the graph below:

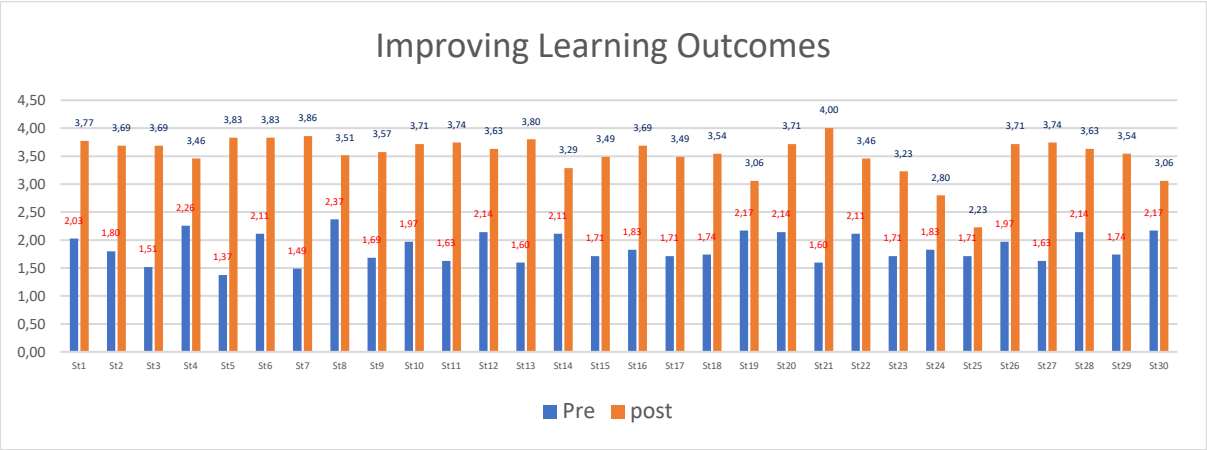

Figure 1. Pretest Postest Students in Abacus Learning

The bar chart displays the learning outcomes of 5-6-year-old children using an abacus, measured through pretest and posttest scores. The blue bars represent the pretest scores, while the orange bars indicate the posttest scores across various students (S1 to S30). The posttest scores are consistently higher than the pretest scores for each student, indicating improvement in numeracy skills after engaging in abacus activities. For example, S1's score increased from 2.05 in the pretest to 3.77 in the posttest, while S21 achieved the highest posttest score of 4.00 from a pretest score of 1.6. This trend suggests that abacus activities positively impact young children's learning outcomes by enhancing their numeracy skills and understanding of mathematical concepts.

Interviews with parents regarding the effectiveness and efficiency of the abacus method in improving the ability to count concepts in children aged 5-6 years resulted in positive responses, as well as an in-depth perspective on the opportunities and challenges posed by this educational approach. Countless parents report significant improvements in their children's understanding of numbers and arithmetic operations, and attribute this progress to the tactile and visual learning experiences facilitated by abacus. Many praised this method for its efficiency in making complex mathematical concepts more accessible and engaging for children, and highlighted the opportunities it provides children to develop a love and fundamental understanding of mathematics from an early age.

However, challenges were also found, particularly in terms of accessibility and the need for specialized instructors. Some parents expressed concerns regarding the search for qualified teachers with the expertise to effectively deliver abacus training and the additional costs and effort required to enroll their children in the program. Despite these challenges, there is strong support for the abacus method, as parents recognize the potential of this method to give their children a competitive advantage in numeracy skills, not only promoting academic success but also cognitive benefits such as improved memory and concentration.

3.2 Discussion

Learning with abacus media has been proven to be effective in improving the concept of counting in children aged 5-6 years. Combining abacus activities can improve children's numerical skills and arithmetic abilities. Utilizing abacus as a learning tool not only helps children develop a solid foundation in arithmetic but also improves their understanding of mathematical concepts from an early age. By engaging in abacus activities, children can improve their numerical sense, which is fundamental for arithmetic development (Cui et al., 2020). According to Rusyani et al (2021), the use of abacus in teaching arithmetic operations has proven to be beneficial in improving children's skills in mathematics, especially in the field of subtraction.

Early childhood learning, especially at 5-6 years old, must pay attention to the stages of child development, both cognitively and socially. The Montessori approach can significantly improve the

process of abacus activities in children aged 5-6 years in the acquisition of the concept of counting. By incorporating Montessori principles into abacus teaching, educators can build a child-centered learning environment, individualized teaching, hands-on experiential learning, increased independence, specially designed educational materials that facilitate exploration and discovery (Courtier et al., 2021). In addition, abacus activities are very suitable for the concrete operational cognitive development of children aged 5-6 years because they have been proven to improve various cognitive functions that are important for mathematical understanding. Research shows that abacus training can improve visuospatial processing, auditory processing, and mathematical abilities in children (Bhavya, Yerrabelli et al., 2022).

Abacus training not only improves the child's cognitive domain but also transfers to other areas of learning, which shows a far-reaching impact on overall cognitive development. In addition, the use of spatial training, such as in abacus activities, has been associated with improved mathematical abilities in children, thus demonstrating a strong association between spatial skills and mathematical proficiency. Therefore, incorporating abacus activities into the educational curriculum for children aged 5-6 years can play an important role in encouraging their cognitive growth, especially in improving their understanding of the concept of counting.

Learning abacus can be a valuable tool for improving arithmetic skills in early childhood. Research shows that early exposure to counting concepts, such as counting and number recognition, is essential for the development of mathematical skills in children (Gashaj et al., 2022). The use of abacus as a learning tool can provide a direct and visual approach to understanding numerical concepts, which can aid in the development of basic math skills (Girard et al., 2022). Additionally, research shows that counting practices at home, including activities such as using abacus, are associated with improved math skills in children, thus highlighting the importance of incorporating numeracy-focused activities in early childhood education (Pan et al., 2022). Therefore, integrating abacus activities into early childhood education can be an effective strategy for improving numeracy skills and laying a solid foundation for future math achievement.

In addition, the benefits of abacus activities go beyond numerical abilities and can also have a positive impact on children's cognitive development. Numeracy skills have been linked to improved executive function, which includes high-level cognitive processes that are essential for academic success (Hudson et al., 2020). By engaging in abacus activities, children not only improve their numeracy skills but also develop executive function skills, such as problem-solving and critical thinking, which are useful for overall cognitive growth (Hudson et al., 2020). Additionally, the interactive and engaging nature of abacus activities can foster positive attitudes toward mathematics and learning in general, contributing to a holistic approach to early childhood education that fosters numeracy skills and cognitive abilities (Girard et al., 2022). Therefore, incorporating abacus activities in an educational setting can be a multifaceted approach to support children's development in the field of numeracy and beyond.

While the benefits of abacus activities in enhancing numeracy skills among young children are evident, scaling this approach across diverse educational settings presents certain challenges, particularly with the increasing emphasis on digital literacy in modern curricula. Implementing abacus programs requires trained instructors who are well-versed in both traditional and hands-on teaching methods, which may not be readily available in all regions. Additionally, as educational priorities shift towards digital competencies, there may be limited resources and institutional support for physical tools like the abacus, which some may view as outdated. Balancing the integration of tactile learning tools such as the abacus with digital literacy skills is essential to provide a comprehensive educational experience. A blended approach, where abacus activities are complemented by digital tools that reinforce numeracy concepts, could address these challenges, ensuring that children benefit from hands-on learning while also preparing them for a technology-driven world.

Criticism of abacus activities in early childhood has centered on concerns about its suitability with modern educational practices and the potential limitations it may pose in promoting holistic

development. Although abacus training has been shown to improve mathematical abilities and cognitive function in children, critics argue that its traditional approach may not be in line with contemporary pedagogical methods that emphasize a more diverse and inclusive learning environment (Beneke & Love, 2022). In addition, children's dependence on abacus activities alone can limit children's exposure to various teaching approaches and technologies that can better meet individual learning styles and needs (Sum et al., 2024). Critics also raise questions about the scalability and adaptability of abacus activities in the context of a rapidly evolving educational landscape, where digital tools and interactive media play an increasingly important role in engaging young learners (Sum et al., 2024). Therefore, criticism of abacus activities in early childhood underscores the need for a more comprehensive and flexible educational approach that integrates various teaching methods to ensure the well-rounded development of the child.

Learning abacus at a young age provides both opportunities and challenges for 5-6 year old children's numeracy skills. Research shows that children who are given arithmetic operational activities from an early age, such as learning simple addition, tend to show better arithmetic performance and growth in the comparison of non-symbolic and symbolic numbers (Susperreguy et al., 2020). Abacus training has been shown to improve cognitive functions related to visuospatial processing, auditory processing, and math skills, thus demonstrating a potential positive impact on numeracy skills (Sanjana & Nisha, 2022). However, the relationship between the math environment at home and numerical skills and patterns in young children is not always clear, suggesting variability in the effectiveness of various approaches (Keyser et al., 2020). Although abacus training has been associated with improved cognitive abilities and arithmetic skills in older children (Bhavya, Dhanalakshmi, et al., 2022), its specific impact on children aged 5-6 years is still not fully understood. Overall, early exposure to abacus may provide cognitive benefits and improve numeracy skills in young children, but the magnitude of this effect and its long-term implications require further investigation.

Efforts to improve abacus activities by developing engaging and effective teaching methods have been investigated in educational research studies. One strategy is to combine fun learning and assessment experiences with eye-catching illustrations of images and colors to create an engaging learning environment for children (Wardat et al., 2022). By utilizing active learning strategies, students become more engaged in the learning process and gain confidence in solving mathematical problems, which can be particularly beneficial for improving their understanding of fractions. In addition, the integration of games in teaching, has been shown to improve student learning by introducing competitive activities that promote effective learning (Badajos et al., 2023). By recognizing the importance of creating an inclusive and engaging learning environment, educators can adapt their teaching methods to meet the diverse needs of students, ultimately improving the overall learning experience and outcomes.

Research on early childhood numeracy skills in abacus activities at Rumah Abpoa Bali tutoring institution has several limitations. One of the limitations is that the study is limited to one tutoring institution, so the results may not be generalized to a wider population. In addition, this study only focuses on basic numeracy skills, without examining other aspects such as problem-solving skills or mathematical applications in daily life. The recommendation for further research is to expand the study and sample size by involving more tutoring institutions in various locations to obtain more representative data. In addition, in-depth research on the long-term impact of abacus use on children's cognitive development and how these methods can be integrated with other teaching techniques to improve learning outcomes is also very important to explore.

4. CONCLUSION

Abacus activities significantly improve the numeracy skills of 5-6-year-olds by providing a hands-on and engaging approach to learning basic arithmetic concepts. Through structured activities that combine visual and kinesthetic elements, children improve their understanding of numbers, addition

skills, and problem-solving abilities. However, challenges remain, such as the need for trained instructors, limited scalability in various educational settings, and the shift towards digital literacy in modern curricula. While abacus activities effectively build an understanding of basic mathematics, the evolving educational landscape requires a blended approach that integrates tactile learning tools such as abacus with digital technologies to create a comprehensive and adaptable learning environment. Future research should focus on examining the long-term impact of abacus use on children's cognitive development and investigate ways to integrate these methods with other teaching techniques to improve learning outcomes across a wider range of skills and contexts.

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