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The Relationship Between Mathematical Literacy and Early Childhood's Habits of Mind

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Abstract

Mathematical literacy supports the importance of children developing a strong understanding of basic mathematical concepts and engaging in mathematical explorations that are relevant to their lives. Mathematical literacy refers to a child's ability to understand and apply basic mathematical concepts, while habits of mind include deep thinking habits such as critical, creative, and reflective thinking. This study aims to explore the relationship between mathematical literacy and habits of mind in early childhood. This study used a quantitative approach with a correlational design, involving 28 preschool children selected through stratified cluster sampling. Data were collected using a mathematical literacy test, a habits of mind questionnaire, and interviews with parents and teachers. The results showed that there was a significant positive relationship between mathematical literacy and habits of mind ($r = 0.730$, $p < 0.05$). The contribution of habits of mind to mathematical literacy was 53.3%, indicating that good habits of mind play an important role in improving children's mathematical literacy. So it can be concluded that developing habits of mind through well-planned learning can strengthen early childhood mathematical literacy.

Keywords Early Childhood; Habits of Mind; Mathematical literacy.

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1. INTRODUCTION

Education has a very important role in supporting national development (Dacholfany et al., 2018) through the development of superior Human Resources (HR). Law of the Republic of Indonesia Number 20 of 2003 emphasizes that to maintain the quality of education nationally, evaluations are carried out periodically (Rahman et al., 2021). his evaluation is a form of accountability of education providers to interested parties. One of the government's efforts in conducting national education assessments is through national assessments. In this national assessment, the quality of education is measured based on children's learning outcomes, which include literacy, numeracy and character (Jauhar Syarifah et al., 2023; Indahri, 2021)) as well as the quality of the teaching-learning process and learning climate in educational institutions. This assessment refers to international education evaluation systems, such as PISA, which aims to measure basic life literacy and student competencies relevant to 21st century skills (Solihin et al, 2024).

In Indonesia, the government has emphasized that the objectives of mathematics learning in PAUD are listed in the Merdeka Curriculum, which includes the development of reasoning, problem solving, communication of ideas and symbols, and the application of mathematics in everyday life. One form of literacy integrated in learning in ECD is mathematical literacy (Ashfarina, et al, 2023; Gunawan et al, 2024). Mathematical literacy supports the importance of children developing a strong understanding of basic mathematical concepts and engaging in mathematical explorations that are relevant to their lives. It also emphasizes the use of mathematics in real-life contexts and how children can apply the mathematics they learn in the classroom to everyday situations (Delima et al., 2022)

Mathematical literacy is an individual's ability to think mathematically, formulate, use, and interpret mathematics to solve problems in a variety of real-world contexts. It involves concepts, procedures, facts, and tools used to describe, explain, and predict phenomena (OECD, 2023). Based on TIMSS 2018 data, Indonesia recorded only a score of 397 from an international average of 500 while in the Program for International Student Assessment (PISA) assessment. Improving mathematical literacy requires the application of contextual learning, improving mathematical thinking habits, and increasing exposure to PISA-type questions, which can help students develop better mathematical literacy skills (Nurwahid & Ashar, (2022). Affective abilities also play an important role in supporting mathematics learning. Research shows a positive relationship between students' attitudes and mathematics achievement, one of which is through the development of mathematical habits of mind

(Nuurjannah et al., 2018). This is even more important considering that the mathematical literacy skills of Indonesian students are currently ranked 63 out of 70 countries in the PISA assessment. This ranking shows that mathematical literacy skills in Indonesia still need to be improved, because the higher students' mathematical literacy skills, the better their ability to solve more complex mathematical problems.

In addition, the development of Mathematical Habits of Mind is also very important, especially from an early age. These mathematical habits of mind, which can be considered as part of mathematical disposition, help children develop a more critical and systematic mindset in dealing with mathematical problems. By improving mathematical habits of mind, children can not only understand mathematical concepts better, but can also apply them in the context of everyday life. Habits of mind include intelligent behavior and strong thinking habits in dealing with complex problems (Hendriana et al., 2018). These habits of mind can encourage children to find relationships or correlations between mathematical concepts that have been learned. As explained by Costa & Kallick (2009), building mathematical habits of mind can help children demonstrate positive behaviors, such as using metacognitive thinking, being humorous, and being flexible when solving problems (Satriani et al., 2023); (Rahmawati et al (2021). By developing these habits of mind, children gain a better understanding of the problems they face. Aristotle also argued that habits are the key to success (Miliyawati, 2014) and this can be applied to early childhood's mathematical development.

Mathematical habits of mind, formed from structured thought processes and knowledge, are essential for children in responding to mathematical situations encountered in everyday life. Mathematical literacy, which focuses on the process of solving mathematical problems in the real world, can be one solution in improving children's mathematical literacy skills, while strengthening their overall cognitive development.

This article identifies several gaps in previous studies and presents a unique contribution to the field. Previous research, highlights the general role of education in national development but lacks a specific focus on mathematical literacy or early childhood education, another studies discusses education evaluations without exploring the role of mathematical literacy in these processes, also address national assessments measuring literacy, numeracy, and character but do not delve into how mathematical habits of mind influence early mathematical literacy. Some studies focus on mathematical habits of mind but do not explore their integration with real-world contexts or early childhood education.

The novelty of this article lies in its integration of mathematical habits of mind with mathematical literacy, particularly in the context of early childhood education (PAUD). It emphasizes the critical role of early years in developing foundational mathematical skills and habits, linking them to international assessments like PISA and TIMSS. Additionally, the article highlights the practical application of mathematics in everyday life through contextual learning, providing a unique perspective that bridges theoretical concepts and real-world use.

This study opens up several interesting research opportunities, such as examining the impact of mathematical habits of mind on literacy skills, integrating PISA-like questions in early childhood education, and comparing the effectiveness of conventional versus habit-based teaching approaches. It also raises the potential for exploring the role of educators in fostering these habits and assessing the long-term benefits of early mathematical literacy on cognitive development. By addressing these gaps and offering new insights, this research significantly contributes to enhancing mathematical literacy and habits of mind in young learners.

Thus, the relationship between mathematical literacy and mathematical habits of mind in early childhood not only plays an important role in building the foundation of their academic skills, but also in shaping adaptive and creative ways of thinking in facing life's challenges. Understanding the relationship between the two will provide deeper insights into how these two aspects support each other in children's learning process.

This research aims to explore these connections, with the hope of contributing to the development of more effective learning methods in supporting mathematical literacy and habits of mind at an early age and their potential to improve students' performance in national and international assessments such as PISA and TIMSS. By focusing on early education, the study seeks to identify strategies that can enhance children's ability to think critically, solve problems, and apply mathematical concepts in real-life contexts. The purpose is to bridge the gap between foundational education and the competencies required for 21st-century skills, ensuring that children develop the cognitive abilities and habits necessary for lifelong learning and success. The impact of this research is significant, as it offers insights that can inform curriculum design, teaching methodologies, and policy development in early childhood education. By integrating mathematical habits of mind with literacy development, the findings could help educators foster a deeper understanding of mathematics among young learners, ultimately improving their problem-solving abilities and adaptability to real-world challenges. Furthermore, the study's emphasis on contextual and habit-

based learning provides a framework for nurturing critical thinking and systematic reasoning from an early age, which are essential for national development and global competitiveness.

2. METHODS

This study used a quantitative approach to examine the relationship between mathematical literacy and habits of mind in early childhood. The quantitative approach was chosen to measure relevant variables numerically and analyze the relationship between these variables statistically. The research design used is correlational research, which aims to determine the extent of the relationship between the two variables. (Arikunto, 2019; Sugiyono, 2019). The population in this study were early childhood children aged between 5 to 6 years old who were enrolled in one of the early childhood centers in Padangsidimpuan City. The study sample was drawn using a stratified cluster sampling technique by selecting 28 children who met the inclusion criteria, namely children who were active at school and parents who were willing to give permission for participation. The research instrument consisted of three main tools. First, a habits of mind questionnaire containing 20 questions to measure children's habits of mind, such as open-mindedness, perseverance, creativity and reflection, which were developed based on the habits of mind theory. Second, a math literacy test, which includes 15 questions to measure early childhood math literacy skills, including number recognition, shapes, patterns, and understanding the concepts of space and shape. Third, interviews with parents and teachers were conducted to gather additional information about the development of children's habits of mind and their involvement in activities that support math literacy.

3. FINDINGS AND DISCUSSION

This article aims to explore the relationship between mathematical literacy and habits of mind in early childhood. Mathematical literacy, which includes children's ability to understand and apply basic mathematical concepts, is an important basis for future cognitive development and problem solving. Meanwhile, habits of mind refer to deep and reflective thinking patterns, such as perseverance, openness, flexibility and the ability to think critically in the face of challenges. Through an analysis involving 28 respondents from diverse early age groups, this study aims to identify whether there is a significant relationship between children's mathematical literacy level and their problem-solving mindset. The mathematical literacy variable was measured using a standardized measurement tool that assesses understanding of basic mathematical concepts, while habits of mind were evaluated by observing children's

behavior and responses to various learning situations involving problem solving and decision making.

The findings in this study were carried out using linear regression analysis with the help of the SPSS application. The findings are:

Tabel 1. Descriptive Statistics

	Mean	Std. Deviation	N
Mathematical_Literacy	4.18	.723	28
Habits_of_Minds	20.11	3.190	28

The mean mathematical literacy score of the early childhood participants in this sample was 4.18, with a standard deviation of 0.723, indicating little variation in mathematical literacy scores among the study participants. This indicates that most of the participants had a relatively uniform level of mathematical literacy, although there was some variation to note. The average habits of mind score obtained by the children in this study was 20.11, with a larger standard deviation of 3.190. This suggests that there is greater variation in the children's habits of mind, reflecting individual differences in critical thinking and problem-solving habits.

Table 2. Correlations Results

		Mathematical_Literacy	Habits_of_Minds
Pearson Correlation	Mathematical_Literacy	1.000	.730
	Habits_of_Minds	.730	1.000
Sig. (1-tailed)	Mathematical_Literacy	.	.000
	Habits_of_Minds	.000	.
N	Mathematical_Literacy	28	28
	Habits_of_Minds	28	28

Based on the correlation results displayed, the interpretation of the relationship between Mathematical Literacy and Habits of Mind that occurs is the Pearson Correlation value (r) = 0.730 between Mathematical Literacy and Habits of Mind, this value indicates that there is a strong positive relationship between mathematical literacy and habits of mind in early childhood. This means that the higher the level of mathematical literacy of a child, the higher the tendency to have good habits of mind, such as perseverance, reflective thinking, and problem-solving skills.

The very small p-value ($p < 0.05$) indicates that the relationship between mathematical literacy and habits of mind is statistically significant. In other words, this result indicates that the relationship is not coincidental and can be trusted as a valid result. This significant and strong relationship between mathematical literacy and habits of mind suggests that the development of basic mathematical skills in children

can play a role in promoting positive habits of mind, which are essential in facing the challenges of learning and everyday life. The findings support the idea that the two factors interact and support each other in early childhood cognitive development.

In accordance with was conveyed by McClure (2017) which states that literacy, especially in the context of science, technology, engineering and mathematics (STEM) literacy, is closely related to habits of mind. Literacy in the STEM context includes not only the ability to read and write, but also the ability to think critically, solve problems and apply knowledge in various contexts. In addition, McClure also emphasizes that habits of mind, such as reflective thinking, perseverance, flexibility, and creativity, play an important role in helping children develop the ability to deeply understand STEM concepts. These habits of mind are mindsets that support children to continue learning and developing even when they face challenges or failures in the learning process.

Mathematical literacy and Habits of mind have a strong positive relationship, as these habits of mind encourage students to think critically, creatively, and reflectively in solving problems, while in the context of mathematical literacy, habits of mind help students formulate problems into mathematical form, use mathematical models effectively, and interpret results appropriately. Research shows that students with high habits of mind have better mathematical literacy skills than those who are low, because they are able to explore mathematical ideas, identify problem-solving strategies, and reflect on the correctness of the answers obtained (Alamudin et al., 2022; Siti Rahmatina et al., 2022). Empirical research shows that habits of mind contribute significantly to mathematical literacy, where students with strong habits of mind show a positive correlation of up to 39.8% to mathematical literacy achievement. Thus, developing habits of mind through planned learning not only strengthens students' mathematical abilities, but also improves their skills in applying mathematical concepts to solve problems in everyday life (Forsman, 2016; Jerau et al., 2021; Purwasih et al., 2018). Overall, habits of mind serve as a cognitive and affective foundation to support students' mathematical literacy development. Learning that emphasizes the development of habits of mind can produce students who are not only proficient in mathematics but also able to apply these skills in real-life contexts.

Table 3. Model Summary Regression Analysis Result

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.730[a]	.533	.515	.503

a. Predictors: (Constant), Habits_of_Minds

Based on table 3, it can be seen that the R value of 0.730 indicates a fairly strong relationship between Habits of Mind and mathematical literacy variables. The R Square value of 0.533 indicates that 53.3% of the variation in early childhood mathematical literacy can be explained by Habits of Mind. In other words, the contribution of Habits of Mind to changes in early childhood mathematical literacy skills is quite large. The Adjusted R Square value of 0.515 is slightly lower than the R Square, indicating that if the model is applied to a wider population, about 51.5% of the variation in mathematical literacy can still be explained by Habits of Mind. This adjustment is important to avoid bias due to the number of predictors used. These results show that mathematical literacy has a significant contribution to early childhood habits of mind, making it an important predictive factor. However, 46.7% of the variation in the dependent variable is still influenced by other factors not included in the model. Therefore, the model can be improved by considering additional predictors to explain greater variation.

A significant relationship between mathematical habits of mind and mathematical literacy. High mathematical habits of mind can improve students' mathematical literacy. This confirms that good habits of mind - such as critical thinking, creativity and perseverance in solving problems - contribute greatly to improving students' ability to understand and solve mathematical problems. Therefore, it is important to develop students' mathematical habits of mind in mathematics learning to improve their mathematical literacy (Az-Zahra et al., 2022; Rastuti & Setyaningrum, 2024; Wahyuningsih et al., 2023)

In line with these results, research results from Malasari et al. (2019) found that habits of mind made a positive contribution of 43.5% to students' mathematical literacy skills, which means that good habits of mind in mathematics (such as critical thinking, creativity, and perseverance in solving problems) can improve students' mathematical literacy skills, especially in the context of geometry. In other words, improving habits of mind can be an effective strategy to improve students' ability to understand and solve mathematical problems, especially in more complex material.

This shows that habits of mind play an important role in the development of mathematical literacy. Students with high habits of mind are more likely to succeed in framing mathematical problems and applying mathematical concepts. However, to develop skills in interpreting and evaluating mathematical results, more specific teaching and support is needed.

4. CONCLUSION

This study concludes that there is a significant and positive relationship between mathematical literacy and habits of mind in early childhood, with habits of mind contributing 53.3% to the development of mathematical literacy. Children with stronger habits of mind—such as critical, creative, and reflective thinking—are better equipped to understand and apply basic mathematical concepts. This highlights the importance of integrating the development of these habits into the mathematics learning process to strengthen children's mathematical literacy and cognitive skills.

Despite its valuable findings, the study has some limitations. It does not extensively explore external factors, such as parental involvement, socio-economic conditions, or cultural influences, which may also play a significant role in shaping mathematical literacy. Additionally, the study lacks an in-depth investigation of specific teaching strategies that could effectively enhance both habits of mind and mathematical literacy. Future research should address these gaps by examining external influences, identifying practical and effective pedagogical approaches, and conducting longitudinal studies to explore the long-term effects of early interventions. Expanding the research to include diverse populations and educational contexts would further enhance the relevance and applicability of the findings.

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