



## Improving primary school numeracy literacy through play interventions and home-school partnerships

Cucu Maryam<sup>1</sup>, Rina Heryani<sup>2</sup>

<sup>1,2</sup>Universitas Pendidikan Indonesia, Bandung, Indonesia  
[cucumaryam85@gmail.com](mailto:cucumaryam85@gmail.com)<sup>1</sup>, [rinaheryani@upi.edu](mailto:rinaheryani@upi.edu)<sup>2</sup>

### ABSTRACT

Numeracy literacy is an essential basic skill for primary school students, including counting, understanding patterns, reading data, and applying mathematical concepts in everyday life. However, low interest in learning mathematics and limited parental involvement are challenges in strengthening numeracy literacy at the primary level. This study explores the effectiveness of play-based interventions and home-school partnerships in improving numeracy literacy in primary schools. The main reason for this research is to find fun learning strategies while encouraging active parental involvement to strengthen children's understanding of mathematical concepts. A qualitative approach with a case study design was used in this study involving teachers, low-grade students, and parents in an elementary school that implemented play-based learning and home-school collaboration. Data were collected through observation, in-depth interviews, and documentation. The results showed that game-based learning effectively improved students' motivation and understanding of mathematics concepts. In addition, parents' involvement in counting activities at home also strengthens students' learning outcomes. This research recommends the integration of fun and collaborative learning methods to improve the quality of basic education.

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### ABSTRAK

Literasi numerasi merupakan keterampilan dasar yang sangat penting bagi peserta didik sekolah dasar mencakup kemampuan berhitung, memahami pola, membaca data, hingga menerapkan konsep matematika dalam kehidupan sehari-hari. Namun, rendahnya minat belajar matematika dan keterbatasan keterlibatan orang tua menjadi tantangan dalam penguatan literasi numerasi di tingkat dasar. Penelitian ini bertujuan untuk mengeksplorasi efektivitas intervensi berbasis bermain dan kemitraan rumah-sekolah dalam meningkatkan literasi numerasi di sekolah dasar. Alasan utama penelitian ini yakni mencari strategi pembelajaran yang menyenangkan sekaligus mendorong keterlibatan aktif orang tua guna memperkuat pemahaman konsep matematika anak. Pendekatan kualitatif dengan desain studi kasus digunakan dalam penelitian ini melibatkan guru, peserta didik kelas rendah, dan orang tua di sekolah dasar yang menerapkan pembelajaran berbasis permainan serta kolaborasi rumah-sekolah. Data dikumpulkan melalui observasi, wawancara mendalam, dan dokumentasi. Hasil penelitian menunjukkan bahwa pembelajaran berbasis permainan efektif meningkatkan motivasi dan pemahaman konsep matematika peserta didik. Selain itu, keterlibatan orang tua dalam aktivitas berhitung di rumah turut memperkuat hasil belajar peserta didik. Penelitian ini merekomendasikan integrasi metode pembelajaran yang menyenangkan dan kolaboratif untuk meningkatkan kualitas pendidikan dasar.

**Kata Kunci:** intervensi bermain; kemitraan rumah-sekolah; literasi numerasi; pembelajaran kolaboratif; pendidikan dasar

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## **INTRODUCTION**

The rapid development of information technology has brought significant changes in various aspects of life, including in the field of education. One of the essential skills that is increasingly needed in this era is numeracy literacy. Numeracy literacy not only includes basic skills in arithmetic, but also includes understanding data, patterns, and the application of mathematical concepts in daily life (Fitriana & Ridlwan, 2021). Literacy also plays a role in improving individuals' ability to think critically, solve problems, and make wise decisions (Anggara & Aulya, 2024; Komara & Hadiapurwa, 2023). This ability is the key to building the critical thinking and reasoning needed to solve various problems (Sajdah *et al.*, 2024).

Facts in the field show that many students still have low numeracy literacy skills. Understanding of problems, especially in geometry and measurement materials. Although the questions are designed to be oriented to everyday life, many students find them unfamiliar because they have never interacted with similar forms of questions before. Lack of familiarity with contextual problems in the learning process causes students to not be able to solve problems that require understanding of complex contexts and modeling (Rahmawati, 2022). This also has an impact on the low mathematical thinking ability which is essential in mastering numeracy literacy. In addition, the results of the National Assessment show that most students have difficulty in reading and understanding number-based information (see at: <https://pusmendik.kemdikbud.go.id/>) so innovative and collaborative learning strategies are needed to improve students' numeracy literacy.

These difficulties can have an impact on their academic achievement as well as their ability to face future challenges (Yekti & Mufarrihah, 2022). Limitations in numeracy literacy can hinder individuals in understanding and analyzing number-based information that is the basis for decision-making in various aspects of life, both in academic and non-academic contexts. Therefore, an effective learning strategy is needed to improve students' numeracy literacy, so that they can adapt to the times and become individuals who are ready to face future challenges. Numeracy literacy in elementary school is the foundation of academic success, laying the foundation for future mathematical understanding and problem-solving skills (Hadiapurwa *et al.*, 2023).

Research has shown that early interventions, at-home numeracy practices, and innovative teaching methods can significantly improve children's numeracy skills. Previous research has explored how fun interventions and home-school partnerships can be leveraged to improve numeracy literacy in primary school students, drawing on insights from recent research. The numeracy literacy ability of students in schools is an important indicator in describing the learning process they undergo. The formation of this ability should ideally start from the elementary school level. Schools that implement numeracy literacy have been proven to have a positive impact on students' reading and writing skills (Peng, 2015). Numeracy literacy includes knowledge and skills in using basic mathematical numbers and symbols to solve everyday problems, analyzing various information in various formats, and understanding the results of analysis to make predictions and decisions (see at: <https://www.kemdikbud.go.id/main/blog/2017/06/literasi-numerasi-dalam-pendidikan>).

Support from the surrounding environment, both at school, at home, and in the community is needed to improve students' numeracy literacy. In this case, teachers and parents need to first thoroughly master the concepts of mathematics that will be taught to children, so that the process of delivering the material is effective (Hakim, 2017). The numeracy skills developed in early childhood are essential for long-term academic success. Research shows that children from low socioeconomic status (SES) backgrounds often start school with less developed math knowledge compared to their peers from higher SES backgrounds (Novita *et al.*, 2024). These differences can affect children's math abilities in the future. These early differences can have long-term consequences, as children who start out lagging behind in math skills often stay behind throughout their academic journey (Siegler, 2009).

Research shows that early intervention can help bridge this gap (Siegler & Ramani, 2008). One effective approach is the use of linear numerical board games. The game has been shown to improve numerical quantity knowledge, line estimation, counting, and number identification in preschoolers from low-income families (Siegler, 2009). For example, playing a simple number board game for just four 15-minute sessions can eliminate the difference in numerical estimation proficiency between low-income and affluent children (Siegler & Ramani, 2008). Such interventions are inexpensive and can be easily implemented in classrooms and homes.

Another promising intervention involves fun exercises involving quantity and numerical transformations. In mathematics, students are encouraged to be involved in mathematics activities every day (Heryani & Trianto, 2023). These activities include thinking solutions in daily life through various mathematical cases, practicing mathematical operations with addition, subtraction, multiplication, and or division, and solving problems found in daily life. Activities in mathematics are correlated with what teachers are currently teaching to reinforce what students have learned.

This research offers a scientific novelty by integrating a play-based learning approach and home-school partnerships in the context of improving numeracy literacy in primary schools. Although many studies have addressed the two separately, this study focuses on the combined impact of the two approaches in creating a supportive learning environment at home and at school. In addition, another novelty lies in the emphasis on the socioeconomic differences of students in accessing and understanding numeracy literacy. This study attempts to explore how play-based approaches can be adapted to support children from different socioeconomic backgrounds, especially at the primary school level, as well as the relevance of contextual approaches closer to their daily lives. Another novelty lies in the use of technology in numeracy literacy learning, which is now increasingly relevant in the digital era.

This study explores the use of learning applications and digital tools that can support numeracy learning activities, both at school and at home, in the hope of offering a more enjoyable and effective learning experience. In addition, this study proposes a more intensive collaborative learning model between teachers and parents, in order to improve communication and cooperation in supporting the development of students' numeracy. The introduction of this model provides a new perspective on the dynamic relationship between school and family in improving the quality of children's education, especially in the field of

numeracy literacy. The results of this study are expected to be recommendations for educators and policymakers in developing more effective learning strategies.

Numerical games and counting practices at home are two approaches that have been proven to be effective in improving children's numerical understanding. Game-based interventions can make children more interested in number concepts, while parental involvement in counting practices at home can strengthen children's understanding of math concepts in an ongoing manner. In addition, fun learning strategies in the classroom can make a positive contribution to developing students' numeracy skills. This article aims to discuss how play interventions and home-school partnerships can improve numeracy literacy in primary schools. In particular, this article examines the forms of effective intervention, the active role of parents and teachers, and their impact on improving students' numeracy skills in the early grades.

## **LITERATURE REVIEW**

### **Play Interventions in Numeracy Learning**

The play-based approach in numeracy learning in primary school is a relevant and effective strategy to build an early understanding of mathematics concepts in children. In the context of the independent curriculum, differentiated learning that combines elements of play has been proven to increase student involvement in the learning process. Play activities such as numerical projects, board games, and modified traditional games can provide a fun and meaningful learning experience for students (Kurniasih & Priyanti, 2023; Seftriyana & Megasari, 2025). Play not only helps with the mastery of number concepts, but also encourages children to actively explore patterns, basic operations, and counting strategies through social interaction and contextual problem-solving. For example, the use of snake and ladder media in numeracy learning has been proven to significantly improve children's numeracy skills because it is attractive and involves movement and strategy (Hasibuan *et al.*, 2022).

In addition, the approach to play is in line with the principles of meaningful and fun learning that are the main characteristics of education at the elementary level (Ngaisah & Aulia, 2023). Considering students' learning styles, interests, and cognitive development stages, the approach to playing in numeracy allows for more inclusive and adaptive learning, and supports the achievement of optimal numeracy learning goals. Furthermore, the playful approach in numeracy learning plays an important role in increasing learning motivation. Students who participated in game-based mathematics learning showed better increased interest in learning, active participation, and better final evaluation results than the control group. This is in line with the constructivist approach that suggests that children learn best when they are actively involved and have control over their learning process (Fitriana & Ridlwa, 2021).

### **Home-School Partnership in Supporting Numeracy Literacy**

Partnerships between home and school are one of the key factors in supporting the development of students' numeracy literacy. Parental involvement not only affects children's

learning attitudes, but also directly correlates with increased academic achievement, including in mathematics (Cahyati & Kusumah, 2020). Partnerships between schools and families are one of the important pillars in supporting the development of students' numeracy literacy at the elementary education level. The active role of parents in the child's learning process at home not only complements learning activities at school, but also strengthens logical thinking skills, understanding of basic mathematical concepts, and *children's problem-solving skills* in the context of daily life (Phillipson & Phillipson, 2012).

Parental involvement is not only limited to providing learning facilities, but also as facilitators who present a fun and meaningful learning experience. Synergy between teachers and parents is needed in providing literacy stimulation from an early age. Activities such as reading stories, introducing letters and numbers, and having regular dialogues with children have been proven to have a positive impact on children's academic readiness, including numeracy skills. Simple but consistent interventions at home can create strong literacy habits, especially when done with a playful and interactive approach. Numeracy literacy activities carried out together at home, such as counting everyday objects, identifying shapes and patterns, or playing number boards, can be an effective vehicle to train children's cognitive abilities naturally (Widiyanto & Nurfaizah, 2023).

This kind of support can also be strengthened by schools by providing guidance media, activity modules, or training programs for parents to have understanding and skills in accompanying children to study at home. Through a harmonious partnership between home and school, the learning process becomes more integrated and sustainable. Children gain a consistent learning experience in their two main environments, namely school and home, which ultimately supports the achievement of optimal numeracy literacy. In Indonesia, home-based learning guidelines developed by the Ministry of Education and Culture (see at: <https://bersamahadapikorona.kemdikbud.go.id/>). Practical strategies for parents in accompanying children to study at home need to be provided.

### **Learning Strategies That Improve Numeracy**

The application of innovative learning strategies such as *project-based learning*, *problem-based learning*, and integration with real-life contexts has proven effective in improving students' numeracy literacy. Innovative learning strategies can improve students' critical thinking skills, so it is important to implement the right learning strategies (Alfitriani *et al.*, 2021). The project-based approach provides space for learners to apply mathematical concepts in real-world contexts, strengthening conceptual understanding and problem-solving skills. Therefore, teachers need to use interesting and fun learning strategies. One way that can be done is to use educational game media such as numeracy ladder snakes.

The use of media has been proven to increase students' enthusiasm for learning by playing while learning, students become more active, interested, and easy to understand the material being taught. In addition, learning with games such as snakes and ladders can also make the classroom atmosphere more lively and not boring. Students can learn to count, solve problems, and work together with friends in groups. This not only improves numeracy skills, but also trains cooperation and communication. In order for this strategy to be successful, teachers need to be trained to be able to design and use appropriate learning media (Handayani *et al.*, 2021). The teaching and learning process will run better and

students can more easily understand mathematics material that was previously considered difficult (Ardi & Desstya, 2023).

## **The Role of the Home Environment in the Development of Numeracy**

The home environment has a central role in the development of numeracy literacy from early childhood to elementary school level. Everyday activities such as shopping, playing cards, or cooking can be contextual math learning opportunities. Homes that provide numeracy activities consistently and explicitly through board games, dialogues about numbers, or reading numeracy books contribute significantly to children's math readiness in school. In addition, parents' belief in the importance of math also affects how often they engage in numeracy support activities at home (Niklas & Schneider, 2017). Parents who have high academic expectations and have the perception that Mathematics as an important life skill tend to be more active in providing numeracy stimulation in the home environment. Therefore, interventions that target changing perceptions and improving parental literacy in supporting numeracy are important steps in the strategy to improve students' numeracy sustainably.

## **METHODS**

This study uses a qualitative method with a case study approach to understand in depth how play-based interventions and home-school partnerships can improve numeracy literacy in primary schools, in line with what Tisdell conveyed in his book "*Qualitative Research: A Guide to Design and Implementation*". The research design used is qualitative descriptive. The subjects of the study included teachers, students in the lower grades (grades 1-3), and parents of students in one of the elementary schools that implemented play interventions and home-school partnerships. The research location was chosen purposively, namely elementary schools that have implemented play-based learning strategies and involve parents in the child's learning process.

This study uses several diverse data collection techniques to obtain rich and in-depth data. The first technique is participatory observation, where researchers directly observe the learning process in the classroom, students' interaction with play media, and parental involvement in supporting learning at home. This observation was carried out during several learning sessions to get a clearer picture of the dynamics of interaction in game-based numeracy learning activities. Second, in-depth interviews with teachers, students, and parents. These interviews aim to explore their experiences, understand the challenges they face, and explore the impact of the interventions that have been implemented.

Interviews are conducted using semi-structured interview guidelines that allow researchers to explore relevant topics while remaining flexible in answering questions that arise. These interviews give participants the opportunity to share their perspectives more freely and deeply. Third, documentation techniques were used in this study, which included data collection from learning notes, photos of activities, and students' work results before and after the implementation of the intervention (Bowen, 2020). This documentation provides visual and written evidence that helps illustrate learners' development and implementation of interventions in more detail.

This study uses data triangulation to ensure the validity and credibility of the data. Data triangulation was carried out by comparing the results obtained from the three data collection techniques used, namely observation, interviews, and documentation. Findings arising from observations and interviews are compared with data obtained from documentation to ensure the consistency and accuracy of the information obtained. This process helps identify potential biases that can arise from each technique and strengthens the credibility of the research results.

## **RESULTS AND DISCUSSION**

### **Parental Involvement Rates in Numeracy Learning at Home**

Based on the results of interviews with parents, it was found that their level of involvement in helping children develop numeracy skills at home varied. Most parents often do counting activities with their children, either through formal exercises such as doing math problems or in everyday situations such as counting pocket money, shopping, or playing counting games. Parental involvement in formal numeracy practices improves children's numerical comprehension.

### **Parents' Strategies in Supporting Children's Numeracy Learning**

Parents play a very important role in supporting children's numeracy development. Many parents use a variety of learning strategies that are not only limited to conventional methods, but also involve fun and interactive activities. One of the main strategies that is widely applied is the use of games that involve numbers. Games such as number puzzles, snake and ladders, buying and selling games, and congklak can be an effective means to introduce numeracy concepts to children in a fun way. This kind of activity allows the child to understand basic mathematical operations such as addition, subtraction, and multiplication in more contextual and applicative situations. In addition, some parents are leveraging technology by using digital learning apps specifically designed to improve their children's numeracy skills.

Learning apps often provide interactive exercises that can be tailored to the child's ability level so that they can learn independently in a more flexible setting. The use of the app allows children to learn anytime and anywhere, as well as giving them the opportunity to practice numeracy skills outside of school hours. In addition, the application of the concept of numeracy in daily life is also an important strategy that is often used by parents. For example, teaching children to manage pocket money and count the number of items when shopping. Activities like these not only hone children's numeracy skills, but also provide a practical understanding of how mathematics is applied in everyday life. The active role of parents is very important in supporting children's numeracy learning, especially at the elementary school level. One of the strategies that is widely applied is to integrate play activities that contain elements of numbers.

Games such as snake and ladder, buying and selling, and congklak can be effective means of introducing basic math operations in a fun and contextual way. The medium of snake and ladder games can increase motivation to learn numeracy and make the learning atmosphere

more interactive (Ardi & Dessty, 2023; Syawaluddin *et al.*, 2020). Another strategy that is no less important is to associate numeracy learning with daily activities. For example, children are invited to count change when shopping, estimate the amount of cooking ingredients, or manage pocket money. This approach helps children understand that mathematics has practical uses in their lives (Rosyada *et al.*, 2024). Overall, the diversity of strategies implemented by parents—whether through games, digital applications, or teaching in the context of daily life—is a very effective approach in improving children's numeracy literacy. Therefore, the active role of parents is essential in creating an environment that supports better numeracy learning for children.

### **Parents' Views on Game-Based Learning**

Most parents have a positive view of game-based learning in improving their children's numeracy skills. They believe that this method makes children understand number concepts faster, increases motivation, and reduces boredom in learning math. In addition, this method also makes children more focused and interested in learning to count, so they can remember math concepts more easily. Game-based interventions can improve children's numerical abilities in a fun and effective way (Siegler & Ramani 2008).

### **Challenges in Home-Based Learning Assistance**

Several challenges remain faced in supporting children's mathematics learning at home. The main obstacle faced by parents is time constraints, especially for those who have busy work. In addition, some parents have difficulty explaining math concepts in a way that is easy for children to understand, especially if they have limitations in math comprehension. Children's lack of interest in learning to count is also an obstacle in building consistent learning habits at home. Therefore, the role of schools in guiding parents, both through training and the provision of supporting resources, is very important to increase the effectiveness of home-school partnerships in supporting numeracy literacy.

### **Implications of Findings on Strengthening Numeracy Literacy**

Overall, the results of these interviews support the findings in the literature that game-based interventions and home-school partnerships contribute significantly to improving the numeracy literacy of primary school students. Active involvement of parents in counting activities at home, the use of games as a learning tool, and good communication with the school so that children can develop a stronger understanding of numeracy. Therefore, a more systematic strategy is needed to involve parents in supporting children's numeracy development, such as the provision of easy-to-understand teaching materials and educational programs for parents on how to assist children in learning mathematics at home.

### **Discussion**

The results of interviews with teachers show that game-based learning has a positive impact on improving students' numeracy literacy (Miller, 2018; Raharjo *et al.*, 2024). Most teachers said that the game method makes learning more interesting and increases the motivation of students (Zafar *et al.*, 2022). Through games, learners can understand mathematical

concepts more concretely and get hands-on feedback that strengthens their understanding. In addition, the active involvement of students in the learning process also increases so that learning becomes more meaningful with games (Shaliha & Fakhzikril, 2022). These findings are in line with previous research that proved that number-based games can significantly improve children's numerical comprehension (Siegler & Ramani 2008).

Nonetheless, the implementation of game-based learning faces a number of challenges. Teachers often have difficulty in adapting game strategies to the needs of diverse students in the classroom. Classroom management during game-based learning is also a challenge in itself, especially in maintaining order and ensuring that all students are actively involved. Limited learning time and students' lack of understanding of technology used in digital-based games are also obstacles. This emphasizes the importance of adequate training support for teachers and the provision of infrastructure facilities that support interactive numeracy learning activities (Phillipson & Phillipson, 2012). In addition, teachers also need to equip them with sufficient digital skills to be able to carry out learning digitally (Kaimara *et al.*, 2021).

In addition, the results of the interviews showed that the involvement of parents in supporting children's numeracy learning at home was very helpful in the development of children's numeracy skills. Teachers observed that parents actively help children in doing assignments, provide additional exercises, and provide technology-based learning media. People communicate with teachers to ensure children's understanding of numeracy materials. Parental involvement in formal numeracy practices at home contributes positively to children's arithmetic fluency (Widiyanto & Nurfaizah, 2023).

## CONCLUSION

This study shows that game-based learning interventions combined with home-school partnerships have a positive impact on improving numeracy literacy of elementary school students. Through the approach to play, students become more active, enthusiastic, and easily understand the concept of numeracy concretely. Parental involvement in learning activities also strengthens the results achieved, as it supports the child's continuous learning process both at school and at home. Good communication between teachers and parents also increases the effectiveness of learning, making it more integrated. Based on these findings, it is recommended that teachers continue to develop creativity in designing game-based learning to support the improvement of numeracy literacy. Fun learning through games is effective in building an understanding of basic math concepts in children. In addition, parental involvement needs to be enhanced through positive partnerships between schools and families. Involving parents in the child's learning process can create continuity between learning at home and at school, so that children receive optimal support. Schools are expected to facilitate effective communication with parents through regular meetings, workshops, or other communication media. Good collaboration between school and home, and supported by teachers who are skilled in using a play approach so that numeracy literacy learning is expected to run more effectively and fun for students.

## **AUTHOR'S NOTE**

The author declares that there is no conflict of interest related to the publication of this article. The author asserts that the data and content of the article are free from plagiarism. Can add a thank you to this section.

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