THE INFLUENCE OF PAPEA (NUMBER ADVENTURE BOARD) MEDIA ON MATHEMATICS LEARNING OUTCOMES OF THIRD-GRADE ELEMENTARY STUDENTS

Ruth Silvia Sinaga[1], Daniar Rahmah Dinita[2], Fahrur Rozi[3], Ellianawati[4]
[1,2,3,4]Pendidikan Dasar Sekolah Pasca Sarjana, Universitas Negeri Semarang,
[1]dinitadaniarr@students.unnes.ac.id, [2]ruthssinaga1501@students.unnes.ac.id,
[3]frozi@mail.unnes.ac.id, [4]ellianawati@mail.unnes.ac.id

ABSTRACT

This study examined the effect of Papea (Papan Petualangan Angka) on third-grade students' mathematics learning outcomes, particularly in understanding whole numbers and place value. Using a one-group posttest-only quasi-experimental design with 42 participants, the study found that the use of Papea significantly improved students' performance, as reflected by the increase in the mean score from 40.79 to 78.95 and the paired-sample t-test result of $t = -10.50$ ($p = 1.20 \times 10^{-12}$). These findings indicate that Papea effectively enhances students' comprehension of numerical concepts, supports more accurate problem solving, and increases engagement during learning activities.

Keywords: numeracy, mathematics, learning outcomes

A. Introduction

Numeracy skills constitute a fundamental competency that plays a crucial role in developing students' mathematical thinking abilities in elementary school. Numeracy is not merely defined as the ability to perform simple calculations; rather, it encompasses the capacity to understand, use, interpret, and communicate numerical concepts and arithmetic operations across various real-life contexts. Yustitia, Kusmaharti, and Irawan (2024) explain that, particularly at the elementary school level, numeracy functions as the foundation for all subsequent mathematical learning. Therefore, weak numeracy mastery can directly impact students' low learning outcomes in mathematics. In Grade 3 mathematics learning, one of the essential numeracy competencies is the understanding of whole numbers, especially the concept of place value. Whole numbers are non-negative integers that form the basis for all higher mathematical operations, and place value represents the structural principle that determines how students interpret the magnitude of a number, classify units,

tens, and hundreds, and perform operations accurately. Without a solid grasp of place value, students are likely to experience misconceptions such as reversing digits (for instance, writing 45 as 54), performing incorrect operations, or failing to read and write numbers correctly.

This problem is also found among Grade 3 students at SDS HKBP Pearaja, Tarutung Subdistrict, North Tapanuli Regency, where classroom observations reveal that students frequently make errors in determining place value and calculating whole numbers. Students' numeracy ability is categorized as low, characterized by frequent misunderstandings regarding tens and hundreds, as well as difficulties in solving addition and subtraction problems involving whole numbers. This condition aligns with findings from several studies indicating that poor understanding of place value is one of the main causes of low mathematics achievement among elementary school students (Indriani et al., 2025). Consequently, there is a need for innovative instructional strategies that can help students comprehend number concepts in a concrete and engaging manner. One alternative solution is the use of manipulative learning media that enable students to see, touch, and construct the concept of place value through hands-on experiences. In this regard, Papea (Papan Petualangan Angka) serves as a visual–manipulative medium designed to support students in exploring whole numbers through play-based learning activities.

Previous studies have shown that the use of numeral board media is highly effective in improving elementary students' basic arithmetic and numeracy skills. Tawa et al. (2024) found that the use of the Counting Smart Board significantly increased students' numeracy scores from an average of 54.23 to 84.23 after two learning cycles. Similarly, Indriani et al. (2025) demonstrated that place value boards can enhance students' interest and comprehension in learning number structures. Building upon these findings, the use of Papea is considered to have strong potential to improve numeracy skills, particularly in understanding the place value of whole numbers in Grade 3 at SDS HKBP Pearaja. Preliminary observations showed that after the implementation of Papea,

students became more enthusiastic, found it easier to understand number-grouping patterns, and demonstrated improvement in solving problems related to place value and number operations. Besides creating a more enjoyable learning environment, the medium enables students to focus more effectively and engage actively in the learning process, thereby contributing to better learning outcomes.

Based on the problems identified, this study formulates the main research question: How does the use of Papea (Papan Petualangan Angka) influence students' learning outcomes in Grade 3 mathematics? In line with this research question, the primary objective of the study is to determine the effect of using Papea on the mathematics learning outcomes of Grade 3 students at SDS HKBP Pearaja Tarutung. The study is expected to provide theoretical benefits by contributing to the development of learning theories related to manipulative-based mathematics instruction, particularly in enhancing numeracy skills and understanding of whole numbers among elementary school students. The practical benefits are intended for teachers and educational institutions to adopt more effective and engaging learning strategies; for students, who will gain more concrete understanding of place value; and for educational media developers, who may consider Papea as an instructional tool in mathematics learning. From a social perspective, this study has the potential to improve the quality of numeracy education in North Tapanuli Regency, ultimately strengthening students' logical and quantitative thinking skills in daily life.

This study also offers several novelties that distinguish it from previous research. First, it employs Papea (Papan Petualangan Angka), a medium that has not been widely examined empirically, particularly at the Grade 3 level and in the specific context of whole numbers and place value. Second, the research is conducted in the local context of SDS HKBP Pearaja, which possesses unique instructional conditions, student characteristics, and media limitations, thereby providing new perspectives on the use of simple yet effective learning media in non-urban areas. Third, the study not only measures improvements in learning

outcomes but also observes changes in students' affective responses—such as enthusiasm, motivation, and learning comfort—following the use of the medium, which is highly relevant in elementary mathematics education. Thus, this study is expected to provide new contributions to the development of game-based numeracy media that are enjoyable yet effective in enhancing students' learning outcomes.

B. Method

This study employed a quantitative approach with a quasi-experimental design of the one-group posttest-only type because learning outcomes were measured only once after the implementation of the Papea (Papan Petualangan Angka) media in Mathematics instruction. The use of this design was consistent with Sugiyono's (2019) explanation that quasi-experimental designs were appropriate in situations where researchers were unable to fully control external variables but still intended to examine the influence of a treatment on the dependent variable. The participants consisted of all 42 third-grade students of SDS HKBP Pearaja Tarutung, selected through a total sampling technique. This decision aligned with Sugiyono's (2019) view that total sampling was suitable when the population size was small enough for all members to be included in order to obtain more representative research results.

The research instrument was a learning achievement test on whole numbers containing 20 items, and the final score was calculated based on the number of correct responses listed in the research worksheet. The instrument had previously been validated and confirmed to possess adequate validity and reliability before being used for data collection. The research procedure involved delivering the treatment using the Papea media during Mathematics instruction, administering the posttest to all students, and collecting their learning outcome scores. The data were analyzed using descriptive statistics to describe the distribution of student performance, and a one-sample t-test was conducted to determine whether the mean learning outcomes after the use of Papea exceeded the Minimum Mastery Criteria (KKM). This analytical approach reflected Sugiyono's (2019) statement that inferential statistics

function to test hypotheses and determine whether the results of a study can be generalized.

C.Result and Discussion

The findings of this study indicated that the use of Papea (Papan Petualangan Angka) had a significant effect on improving the mathematics learning outcomes of third-grade students at SDS HKBP Pearaja Tarutung. Descriptive analysis of the pre-test and post-test scores administered to 38 students showed a substantial shift in performance following the instructional intervention. Table 1 presents the descriptive statistics and paired t-test results.

Table 1. Pre test, post test, dan t-test

t-Test: Paired Two Sample for Means

	PRE TEST	*POST TEST*
Mean	40,78947	78,94737
Variance	164,2248	285,3485
Observatic	38	38
Pearson Cc	-0,12091	
Hypothesi:	0	
df	37	
t Stat	-10,4993	
P(T<=t) on	5,98E-13	
t Critical or	1,687094	
P(T<=t) tw	1,2E-12	
t Critical tw	2,026192	0,264
	Ha diterima	
	H0 ditolak	

The pre-test results showed that students' average score was only 40.79, with a variance of 164.22, indicating that their initial understanding of whole numbers and place value was both low and inconsistent. After receiving instruction through the Papea media, the mean score increased markedly to 78.95, accompanied by a variance of 285.35. This notable improvement reflected not only enhanced conceptual comprehension but also higher levels of engagement and participation throughout the learning process. The substantial increase in performance suggested that Papea supported students in grasping abstract numerical concepts through concrete and interactive activities.

Inferential analysis using a paired-sample t-test further confirmed the effectiveness of the intervention. The statistical test produced a t-value of –10.50 with a two-tailed p-value of 1.20×10^{-12}, well below the significance threshold of $\alpha = .05$. Therefore, the alternative hypothesis (Ha) was accepted, and the null hypothesis (H0) rejected, demonstrating a significant difference between students' learning outcomes before and after the use of Papea. The Pearson correlation coefficient of –0.12 indicated a very weak

relationship between the two sets of scores, implying that the observed improvement was primarily attributable to the instructional treatment rather than to score linearity between the two measurements. Overall, these findings provided strong empirical evidence that Papea was effective in enhancing students' numeracy skills, particularly in understanding whole numbers and place value, among third-grade learners at SDS HKBP Pearaja Tarutung.

Based on the findings of this study, which demonstrated a significant improvement in the mathematics learning outcomes of third-grade students following the instructional intervention using the Papea media, the results align with previous research emphasizing the importance of concrete manipulatives in supporting numeracy learning and place-value comprehension. For example, Novendra, Heryanto, and Indrayana (2024) reported that the use of a Whole Number Place-Value Board substantially increased both the average score and the percentage of students achieving mastery in elementary classrooms, as learners were able to manipulate digits and construct numerical structures more concretely. Similarly, the study conducted by Ni'mah, Permoni, Anika, and Zuliana (2024), which employed the Indonesian Realistic Mathematics Education (PMRI) approach with a localized learning trajectory, found that visual representations through a place-value board helped students internalize the structure of digit positions, thereby strengthening their understanding of place value in real contexts.

Furthermore, the research by Indriyani, Hidayatus, and Waryuni (2024) indicated that the consistent use of place-value media not only improved average scores but also increased the proportion of students who reached mastery, suggesting that manipulatives can sustainably reinforce students' comprehension of whole-number concepts. These findings closely correspond to the results of the present study, in which post-test scores increased sharply compared with pre-test scores, reflecting substantial conceptual gains after the implementation of Papea. Additionally, a study by Lya (2025) published in Jurnal Pengabdian Indonesia on the use of "number-pocket" media reported that

all students achieved mastery after two cycles of intervention, reinforcing the notion that concrete objects such as number pockets or place-value boards are highly effective in enhancing foundational numeracy skills.

Other supporting evidence comes from the work of Multahada, Fauza, and Zuliana (2025), who implemented a place-value board within the PMRI framework. Their study showed that during the mathematical modeling and reflection stages, students more easily understood the positional value of digits after engaging in concrete activities involving the movement and arrangement of numerical components. Similarly, Syahril and Najwa (2022) developed environmentally friendly manipulatives for teaching multiplication and place value and found that recycled-material media (such as numbered bottle caps) aligned well with children's concrete-operational cognitive development, providing further support that physical manipulation of numbers is particularly suitable for learning place value.

In addition, the validity of manipulatives as instructional media has been evaluated in a study by Wulandari, Hunaifi, and Wiguna (2025), who developed "PAKABI (Number Pocket Board)" and reported high levels of validity based on expert assessments of both material and media quality, indicating its appropriateness for place-value instruction in lower elementary grades. Beyond validity, the conceptual impact of manipulatives has also been demonstrated by Hayati, Mariyam, and Utama (2025), who found that the number-pocket board substantially influenced students' conceptual understanding of whole numbers, supporting the interpretation that the improvement in scores in the present study is attributable primarily to students' active engagement with the media rather than to extraneous factors.

Overall, the convergence of evidence from these studies strengthens the conclusion that Papea, as a concrete and interactive manipulative tool, is highly effective in improving students' basic numeracy skills, particularly their understanding of place value. These findings are not only academically meaningful but

also practically relevant, suggesting that elementary schools may consider integrating Papea or similar manipulative media into their mathematics curriculum to enhance students' comprehension of abstract numerical concepts.

D. Conclusion

This study concluded that the use of Papea (Papan Petualangan Angka) had a significant effect on improving the mathematics learning outcomes of third-grade students at SDS HKBP Pearaja Tarutung. This was evidenced by the increase in the mean score from 40.79 on the pre-test to 78.95 on the post-test, as well as by the results of the paired t-test, which indicated a significant difference between the scores before and after the intervention. These findings demonstrated that Papea effectively supported students in understanding whole numbers and place value more concretely, thereby enhancing their focus, engagement, and numeracy skills. The novelty of this research lay in the development and implementation of Papea as an innovative manipulative medium that integrates elements of play and adventure, enabling it to provide concrete representations of place value while simultaneously boosting students' intrinsic motivation more effectively than traditional manipulatives such as place-value boards or number pockets.

REFERENCES

Alawiah, A., & Ichsan, M. (2017). The use of number lines to improve mathematics learning outcomes of elementary school students. *Jurnal Pendidikan Dasar*.

Hayati, N., Mariyam, M., & Utama, E. G. (2025). The effect of using number pocket board media on students' understanding of mathematical concepts in whole-number material. *JRPD (Jurnal Riset Pendidikan Dasar)*.

Indriani, I., Kurniawati, D., & Rahayu, S. (2025). The application of place-value numeracy board media to increase third-grade students' interest in learning mathematics. *Jurnal Pendidikan Dasar*.

Indriyani, N., Hidayatus, O., & Waryuni, W. (2024). Improving fifth-grade students' mathematics learning outcomes using place-value number media. *PERISAI: Jurnal Pendidikan dan Riset Ilmu Sains, 3*(3).

Lya, D. (2025). The application of number pocket media for place-value material to improve learning outcomes of third-grade elementary students. *Jurnal Pengabdian Indonesia (JPI)*.

Multahada, N., Fauza, Z. S., & Zuliana, E. (2025). The use of place-value board media in the PMRI approach to support mathematics learning in elementary schools. *Linear: Jurnal Ilmu Pendidikan, 9*(1).

Ni'mah, U., Permoni, D., Anika, R. R., & Zuliana, E. (2024). Learning whole numbers using place-value board media: A learning design using the PMRI approach. *APOTEMA: Jurnal Program Studi Pendidikan Matematika, 10*(1), 39–48.

Novendra, A., Heryanto, D., & Indrayana, I. (2024). Attempts to improve students' mathematics learning outcomes through place-value board media in elementary schools. *PEDADIDAKTIKA: Jurnal Ilmiah Mahasiswa PGSD, 11*(3), 521–532.

Puspitasari, R., Azka Zanuba, I. T., Septiarini, N. A., & Pratiwi, I. (2024). Teaching simulation of whole numbers up to 1,000,000 using place-value board media for fifth graders at SD Pancasila. *Journal of Multidisciplinary Inquiry in Science, Technology and Educational Research, 1*(3b), 954–960.

Sugiyono. (2019). *Statistics for research*. Alfabeta.

Syahril, S., & Najwa, W. A. (2022). Development of eco-friendly manipulative media on integer multiplication and place value. *Kariwari Smart: Journal of Education Based on Local Wisdom, 2*(1), 30–37.

Tawa, A., Manafe, Y., & Ekaputra, D. (2024). The use of smart counting board media to improve elementary students' numeracy skills. *Jurnal Citra Bina Pendidikan*.

Wulandari, P., Hunaifi, A. A., & Wiguna, F. A. (2025). Validity criteria of PAKABI (Number Pocket Board) learning media for teaching place-value material to second-grade students. *Pendas: Jurnal Ilmiah Pendidikan Dasar, 10*(2).

Yustitia, D., Kusmaharti, D., & Irawan, D. (2024). Analysis of third-grade students' numeracy skills in whole-number material. *Jurnal Inventa*.