

ANALYSIS OF THE USE OF INTERACTIVE GEOBOARDS TO IMPROVE STUDENTS NUMERACY SKILLS IN THE TOPIC OF PERIMETERS OF TWO-DIMENSIONAL SHAPES IN ELEMENTARY SCHOOL

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Abstract

This study aims to examine the effect of using interactive geoboard media on elementary school students' numeracy skills in learning the perimeter of plane figures. The research employed a quantitative approach with a quasi-experimental one-group pretest-posttest design. Students were given a pretest, followed by learning activities using a geoboard, and concluded with a posttest. The findings indicate that the use of geoboards improves students' accuracy in calculating perimeters and enhances their learning motivation. Therefore, geoboards can be considered an effective alternative learning medium to support numeracy instruction in elementary schools.

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A. INTRODUCTION

Mathematics, as a foundational discipline, constitutes one of the fundamental subjects that plays an undeniably significant role in the development of logical reasoning and numeracy skills among learners, particularly beginning at the elementary school level, where the formative years of education are critical for cognitive development. In the insightful research conducted by Hanifah and Budiman, as documented in the work of Firdaus et al. (2025), it is articulated that the process of mathematical learning transcends the mere training of numeracy; rather, it encompasses a holistic approach that fosters the cultivation of reasoning, creativity, and the critical thinking abilities essential for effectively addressing and resolving everyday challenges that individuals may encounter.

Nevertheless, the prevailing reality indicates that a considerable number of learners continue to perceive mathematics as a daunting and monotonous subject, a sentiment largely attributable to the traditional educator-centered pedagogical approaches employed within the classroom environment, coupled with an evident paucity of engaging and stimulating learning media that could enrich the educational experience. Consequently, these factors collectively contribute to the subpar academic performance of students, particularly in the context of mobile material and flat geometric constructions, which inherently demand a robust set of numeracy skills and a comprehensive understanding of visual concepts.

In accordance with the findings presented by Wahyuni et al. (2024), numeracy can be defined as the capability to comprehend, utilize, and interpret mathematical numbers and symbols within the context of real-life situations, which is imperative for making informed and rational decisions in

everyday life. One effective methodology for nurturing such vital abilities is through the employment of tangible and concrete learning media, such as geoboards or nailed boards, which are simplistic yet effective plank-shaped tools featuring strategically placed nail points that can be interconnected using rubber bands to create a diverse array of flat geometric shapes and configurations. The integration of geoboards into the learning process provides learners with the opportunity to engage directly with the foundational concepts of shape, circumference, and area, thereby rendering the learning experience not only more interactive but also significantly more meaningful and relevant to their understanding of mathematical principles (Lucyana et al., 2025).

Geoboards have been recognized as an exceptionally effective manipulative medium within the realm of mathematical education, especially in relation to the concepts associated with geometry. As articulated by Musser et al. (2019), a geoboard serves as a meticulously designed educational tool intended to facilitate learners in grasping the intricate concepts of area, circumference, and the various properties inherent to geometric structures, all through the engaging and interactive medium of hands-on activities that promote experiential learning.

The endeavor of teaching the concept of flat geometric shapes necessitates the implementation of an appropriate instructional approach to circumvent the potential for misconceptions that may arise during the learning process. According to the scholarly insights provided by Van de Walle et al. (2019), "An understanding of the concept of circumferences should be built through concrete experience in directly measuring side lengths before using mathematical formulas," highlighting the importance of experiential learning in the development of conceptual understanding.

This pedagogical approach aligns seamlessly with the findings presented by Hendra & Suryani (2023) in their comprehensive study entitled "Analysis of Learners' Difficulties in Understanding the Concept of Rectangular Circumference," which elucidated that a significant 65% of grade IV learners encountered substantial challenges in differentiating between the concepts of circumference and area when their learning experiences were predominantly reliant on abstract formulas devoid of any manipulative activities that could enhance their understanding.

Pratama and Wijaya (2021), in their comprehensive and insightful study titled "Development of Digital Geoboard Media to Improve Learners' Spatial Ability," have elucidated that geoboards, which are widely recognized as educational tools, possess significant advantages not only in their traditional, tangible forms but also when they are utilized in digital formats. The findings derived from this meticulous research indicate that the implementation of digital geoboards can lead to a remarkable enhancement in the spatial abilities of learners, with an impressive improvement rate quantified at 32% when compared to the more conventional methods of instruction that have been historically utilized. Consequently, the authors advocate for the ongoing development and integration of digital geoboards as a viable and innovative alternative medium for educational purposes, particularly in light of the

evolving demands and characteristics of the digital age that we currently inhabit.

In addition to this pivotal study, a multitude of other research endeavors have substantiated the efficacy of this educational medium; among these is the significant investigation conducted by Firdaus et al. (2025), which documented a noteworthy elevation in the academic performance of fifth-grade learners, with their average scores rising from a relatively modest 62 to a more commendable 77. Furthermore, another relevant study by Lucyana et al. (2025) meticulously recorded an impressive increase in learning obedience, which escalated from a baseline percentage of 51.58% to an astounding 92.52%. Additionally, Wahyuni et al. (2024) provided confirmation that the integration of a nailboard, when combined with the Problem-Based Learning (PBL) model, is exceptionally effective in promoting numeracy literacy, as it actively engages learners and encourages them to adopt critical thinking strategies while navigating and resolving various problems. Based on the extensive overview provided, it becomes evident that the utilization of interactive geoboards warrants significant academic inquiry, as this approach represents a crucial effort to enhance learners' comprehension of the concept of flat wake roving while simultaneously fostering essential numeracy and critical thinking skills through concrete, active, and enjoyable educational experiences.

The results obtained from these investigations unequivocally illustrate that the incorporation of geoboard media can substantially aid learners in grasping the complex concepts of circumference and area associated with flat wake geometries, all the while simultaneously nurturing their numeracy skills in the process. Central to the focus of this study is the examination of how the application of interactive geoboard media is operationalized within the mathematics curriculum in elementary education, as well as the degree to which the employment of such innovative media can enhance the numeration competencies of learners, specifically concerning flat wrap-around material, while also addressing potential constraints that may arise during the learning process.

B. RESEARCH METHODOLOGY

This research endeavor employed a quantitative methodology that was characterized by a quasi-experimental design, specifically categorized as a one-group pretest-posttest framework, which serves as an effective means of assessing learning outcomes. Within the context of this investigation, a singular cohort of learners was selected as the subjects who actively engaged in the educational process, utilizing the innovative interactive geoboard media specifically tailored for the exploration of two-dimensional flat waking roving materials.

During the initial phase of the study, the participants undertook a pretest, which was meticulously designed to evaluate their baseline competencies in the calculation of the circumference of a flat wake, thereby establishing a reference point for their mathematical abilities. Following the administration of the pretest, the learners were subsequently subjected to a carefully structured learning intervention that harnessed the interactive geoboard media, intended

to facilitate a deeper comprehension of the principles underlying flat wake roving concepts. Upon the conclusion of the instructional phase, a posttest was conducted with the explicit purpose of measuring the enhancements in the learners' capabilities, achieved by contrasting the results obtained from both the pretest and posttest assessments.

This systematic approach not only underscores the effectiveness of utilizing interactive media in educational contexts, but it also provides empirical evidence regarding the advancements in learner performance attributable to the pedagogical strategies employed throughout the study.

C. RESULTS AND DISCUSSION

Based on the empirical investigations undertaken with a cohort of five third-grade learners from a primary educational institution, the utilization of geoboard media within the context of flat wake roving pedagogy demonstrated an exceedingly notable degree of effectiveness in enhancing educational outcomes. This comprehensive study employed a one-group pretest-posttest methodological framework, which incorporated an evaluative instrument composed of three multiple-choice queries along with one open-ended descriptive question designed to assess the learners' understanding and retention of the material. The subsequent analysis revealed compelling results when comparing the performance of the participants in both the pretest and posttest phases, highlighting the significant educational advancements achieved through the intervention. Herein, the detailed outcomes of the pretest and posttest assessments are presented for further examination and consideration, illustrating the impact of the geoboard media on the learners' academic performance.

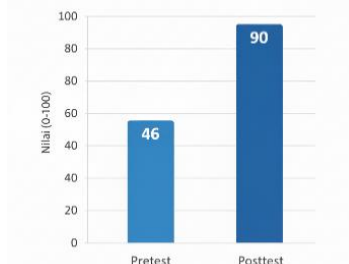
Tabel 5. 1 Hasil Pretest dan Posttest

No.	Name	Pretest score	Posttest score	Improvement
1.	Student 1	60	100	66,67%
2.	Student 2	50	95	90%
3.	Student 3	45	95	111,11%
4.	Student 4	40	90	125%
5.	Student 5	35	70	100%
Rata-rata		46	90	95,65%

The results obtained from the pretest indicated that the average score achieved by the learners was a rather modest 46, suggesting a significant area of concern regarding their understanding of the subject matter. A meticulous and thorough investigation into the various conceptual errors made by the learners uncovered that an alarming 80% of them were grappling with misconceptions specifically related to the differentiation between the concepts of circumference and the flat wake area, highlighting a critical gap in their comprehension. It has been observed that a considerable number of learners tend to erroneously equate the circumference with the notion of breadth, leading to considerable confusion, and as a result, they encounter considerable challenges when attempting to identify which sides should be

summed in order to accurately determine the circumference of a flat wake. This pervasive misunderstanding underscores the necessity for targeted instructional interventions aimed at clarifying these fundamental concepts in order to enhance learners' mathematical proficiency and conceptual clarity.

Figure 5.1 Improvement Diagram



Following a thorough and systematic application of geoboard media as an educational tool, it was observed that the average score achieved by learners on the posttest increased significantly, reaching an impressive figure of 90, which corresponds to an average enhancement of 98.6%. It is noteworthy to mention that each individual learner managed to attain scores that exceeded the established minimum competency standard, often referred to as KKM, which is set at a threshold of 70. A meticulous analysis of the problem items revealed that the scores related to conceptual comprehension experienced a remarkable surge from 1.4 to 3.4, thereby indicating that learners were not merely engaging in rote memorization of mathematical formulas but were also developing a profound and nuanced understanding of the underlying concepts.

The observed variance in the percentage increase in learning outcomes is intrinsically linked to the differing initial abilities that each learner brings to the educational experience. For instance, learners who demonstrated higher pretest scores, such as learner 1, exhibited a comparatively lower percentage increase in their posttest results, as they had already established a robust foundational understanding prior to the commencement of the instructional period. Conversely, learners who began with lower pretest scores, such as learners 3, 4, and 5, displayed a more pronounced percentage increase, which can be attributed to a substantial leap in their comprehension levels following the acquisition of concrete learning experiences facilitated by the use of the geoboard. This observation aligns with the findings presented by Wulandari and Hadi (2022), which assert that the initial capabilities of learners exert a direct influence on the extent of the scores they achieve subsequent to the implementation of the learning intervention.

Moreover, the varying degrees of misconceptions that each learner possesses at the outset of the learning process have also played a crucial role in determining the level of improvement attained by each individual. When the geoboard media assists learners who initially harbor stronger misconceptions in visualizing circumferential and expansive mathematical concepts in a tangible manner, these learners are more likely to experience substantial alterations in their understanding. Fitriani (2021) elucidates that manipulative media possess the inherent capability to gradually rectify misunderstandings, thereby enhancing the overall learning experience.

The individual learning styles of the students, as well as their levels of engagement during the learning process, are equally significant factors that contribute to the overall effectiveness of the educational experience. Certain learners have been observed to display higher levels of activity when manipulating the geoboards, experimenting with various geometric shapes, and articulating their thought processes in an effort to validate their actions. In contrast, learners who exhibit passive behavior do not achieve the same degree of improvement as their more engaged counterparts. This observation is corroborated by research conducted by Suryani and Kurniawan (2023), which indicates that the use of geoboards significantly enhances the learning outcomes for students who possess kinesthetic visual learning styles. Consequently, it becomes evident that a confluence of various factors—including initial ability, preferred learning style, extent of misconception, and active participation in the learning process—contributes to the disparities observed in the learning outcomes among different learners.

In light of the findings derived from this study, in conjunction with other corroborating research, it can be conclusively asserted that geoboards represent an innovative and effective medium for learning that not only enhances cognitive learning outcomes but also fosters a deep and meaningful understanding of concepts, cultivates essential numeracy skills, and promotes a positive disposition towards the field of mathematics. Therefore, it is highly recommended that the systematic implementation of geoboard activities in the context of geometry education within elementary schools be pursued as a means of facilitating meaningful, learner-centered educational experiences that resonate with students on multiple levels.

D. CONCLUSION

This empirical investigation elucidates that the employment of interactive geoboard media serves as an effective catalyst in significantly enhancing the numeracy skills and conceptual comprehension of flat-surface geometric concepts among learners situated within the elementary educational sphere. By engaging in manipulatives that are both tactile and visual in nature, these young learners are afforded the opportunity to grasp the intricate notion of circumambulation with greater precision, thereby simultaneously mitigating the prevalence of common misconceptions that often exist between the concepts of circumferences and expanses. This assertion is substantiated by the observable increase in the average test scores, which remarkably escalated from a mere 46 on the pretest to an impressive 90 on the posttest, thereby highlighting the effectiveness of the instructional strategy employed. Furthermore, beyond merely enhancing cognitive capabilities, the process of learning through the utilization of geoboards fosters a heightened sense of liveliness, motivation, and an increased level of engagement among learners as they embark on the discovery of mathematical concepts, all the while cultivating essential critical thinking skills and enabling them to systematically articulate the steps involved in calculations.

The resultant visual representations afforded by these geoboards significantly contribute to a deeper understanding of geometric shapes, thereby leading to the conclusion that geoboards are deemed highly valuable

as a primary instructional medium for foundational geometry topics, with the potential for broader application across various other mathematical domains. Thus, it becomes evident that integrating such innovative educational tools into the curriculum not only enhances mathematical understanding but also invigorates the overall learning experience, making it more dynamic and interactive for students. In light of these findings, it is imperative for educators to consider the incorporation of interactive geoboards into their teaching methodologies to foster an enriched learning environment that promotes both academic achievement and enthusiasm for mathematics.

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