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ANALYSIS OF THE USE OF GEOGEBRA AS AN INTERACTIVE LEARNING MEDIA IN IMPROVING UNDERSTANDING OF FLAT SHAPE AREA CALCULATION SKILLS IN 3RD GRADE ELEMENTARY SCHOOL

Zakia Az'zahra Qurota'aini[1] Neng Sarah Aprilia[2] Vita Mulyasari[3] Yakub Simamora[4]

[1234]Program Studi Guru Sekolah Dasar, Universitas Lampung,Indonesia

Zakiaaazzahraaq@gmail.com [1] Neng9475@gmail.com [2] vitamulyasari0123@gmail.com [3]
yakubmora8@gmail.com [4]

ABSTRACT

The use of GeoGebra as an interactive learning medium offers great potential in enhancing students' understanding of flat shapes, particularly in the skill of calculating the area of flat shapes in 3rd grade elementary school. This material is considered challenging because it involves abstract concepts such as measurement and calculation. GeoGebra allows for interactive visualization so that students can directly manipulate flat shapes, which helps them build a deeper understanding and enhances their active engagement in learning. This research uses a quantitative descriptive method with data collection techniques through observation, questionnaires, and literature review. The research results show that although GeoGebra is effective in improving students' understanding of the area of flat shapes, there is no significant difference in students' responses regarding the use of this media. The challenges faced include varying levels of technological skills among students, the availability of devices, and the technological infrastructure at the school. Therefore, it is important to enhance teacher readiness and technological infrastructure so that GeoGebra can be used optimally in learning.

Keywords: GeoGebra, interactive learning, area of flat shapes, learning media, elementary school mathematics

A. INTRODUCTION

In the realm of educational pedagogy, particularly concerning the instruction of Mathematics within the context of Elementary School curricula, it is imperative to recognize that one of the pivotal subjects presented to learners, specifically those in the third grade, is the foundational concept associated with flat geometric shapes and the subsequent calculations pertaining to their respective areas. This topic is frequently regarded as one of the more formidable academic challenges that young learners encounter during their formative educational years. The nature of abstract concepts such as area, which fundamentally intertwine with the principles of measurement and numerical computation, often presents significant cognitive hurdles for students to surmount and comprehend effectively. Nevertheless, it is crucial to acknowledge that cultivating a robust and profound comprehension of the principles surrounding the area of flat shapes serves as a vital cornerstone, laying the groundwork for students as they progress towards more intricate and advanced mathematical topics in subsequent educational stages. In light of these challenges, it becomes increasingly evident that fostering innovation within the mathematics instructional process is not merely beneficial but indeed necessary. An intriguing and promising alternative approach in this regard is the integration of technology, specifically through the utilization of interactive learning applications that can enhance educational engagement. One particularly noteworthy example of such technology

is GeoGebra, which stands out as a dynamic and versatile piece of mathematics software that presents considerable potential to function effectively as a comprehensive learning medium. Through its array of interactive features, GeoGebra not only facilitates but actively encourages students to immerse themselves in the learning experience, enabling them to visually explore the nuances of the area of flat shapes while simultaneously constructing a more profound understanding of the underlying mathematical concepts involved. The capabilities of GeoGebra extend beyond mere visualization; it empowers students to manipulate geometric shapes in a direct and hands-on manner. By engaging in a more participatory and active learning experience, students are afforded the opportunity to adjust the dimensions of shapes, observe real-time alterations in area calculations, and thereby cultivate a more intuitive grasp of the mathematical principles at play.

This pedagogical approach transcends rote memorization of formulas, as it fosters a deeper comprehension of the theoretical concepts that underpin the calculation of areas associated with flat geometric shapes. Furthermore, GeoGebra is replete with a diverse assortment of features that not only promote independent exploration of concepts but also aid students in the development of critical thinking and problem-solving skills from an early age. In conjunction with the pressing need for technological advancement and the implementation of innovative pedagogical strategies, it is equally vital for educators to adeptly integrate digital tools into their teaching methodologies. The role of teachers is paramount, as they guide and facilitate students in utilizing GeoGebra as an interactive resource that enriches and enhances their overall learning experience. Within the framework of teaching the area of flat shapes, educators have the opportunity to design engaging activities that empower students to create flat shapes, compute their respective areas, and investigate a variety of shape variations. This interactive learning process can be executed through both independent student work and collaborative group discussions, thereby significantly amplifying student engagement and participation throughout the educational process.

A multitude of empirical studies has consistently demonstrated that the incorporation of digital tools, such as GeoGebra, serves to substantially elevate student motivation and engagement levels within the context of mathematics instruction. Students who take an active role in exploring mathematical concepts and engaging with the content tend to exhibit a deeper understanding and retention of knowledge compared to their counterparts who adopt a more passive learning stance. This compelling evidence underscores the notion that an interactive pedagogical approach not only enriches the educational experience but also plays a crucial role in enhancing student learning outcomes, particularly in the domain of calculating the areas of flat shapes. Given this context, the primary objective of this research endeavor is to conduct a thorough analysis of the application of GeoGebra as an interactive educational medium, specifically focusing on its efficacy in improving the understanding and proficiency of area calculation skills among third-grade elementary school students. This research is anticipated to contribute significantly to the ongoing development of mathematics education by proposing methodologies that are both effective and engaging, while simultaneously offering valuable recommendations to educators regarding the selection and implementation of appropriate learning media designed to

deepen students' comprehension of the concept of area as it pertains to flat geometric shapes.

B. RESEARCH METHOD

The methodological framework employed in the scholarly article under discussion is firmly rooted in a quantitative descriptive approach, which is meticulously designed to systematically analyze and evaluate the utilization of GeoGebra as an innovative and interactive educational medium, with the specific intention of enhancing and improving the proficiency of third-grade elementary school students in calculating the areas of various flat geometric shapes. This particular study encompasses an array of diverse data collection techniques, which include but are not limited to structured observation, the administration of questionnaires, and a comprehensive literature review derived from pertinent academic journals that are closely related to the subject matter at hand.

The observational component of the research was meticulously conducted during the instructional process, with the objective of directly witnessing and scrutinizing the interactions that students engaged in with the GeoGebra media, as well as assessing the extent to which these young learners grasped the fundamental concept of calculating the areas of flat shapes through their engagement with this technological tool. Furthermore, in order to gather quantitative data that reflects the students' personal perceptions and experiences, questionnaires were systematically distributed to the students following the completion of the learning sessions, thus enabling researchers to gain insights into the impact of GeoGebra on their understanding of the material presented.

The data obtained from the questionnaires were subsequently subjected to rigorous analysis utilizing descriptive statistical methods, which facilitated the exploration of both the percentage distribution and frequency of the responses provided by the students. Additionally, the findings and insights gleaned from relevant studies published in academic journals are meticulously employed as valuable references to fortify and enrich the ensuing analysis and discourse regarding the overall effectiveness of GeoGebra as an interactive educational medium. Employing this multifaceted approach, the research aspires to furnish a thorough and well-rounded overview of the consequential effects that the implementation of GeoGebra has on enhancing students' comprehension of fundamental concepts in flat geometry. The integration of these diverse methodologies underscores the commitment to rigor in the research process, ensuring that the conclusions drawn are both valid and reliable. Ultimately, the anticipated outcome of this comprehensive study is to contribute significantly to the existing body of knowledge surrounding the pedagogical advantages of incorporating interactive learning tools such as GeoGebra into the elementary mathematics curriculum.

C. RESULTS AND DISCUSSION

The methodological framework employed in the scholarly article under discussion is firmly rooted in a quantitative descriptive approach, which is meticulously designed to systematically analyze and evaluate the utilization of GeoGebra as an innovative and interactive educational medium, with the specific intention of enhancing and improving the

proficiency of third-grade elementary school students in calculating the areas of various flat geometric shapes. This particular study encompasses an array of diverse data collection techniques, which include but are not limited to structured observation, the administration of questionnaires, and a comprehensive literature review derived from pertinent academic journals that are closely related to the subject matter at hand.

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Moreover, the capacity of this innovative tool to be readily available on the internet without any associated costs significantly enhances its accessibility, thereby contributing to the democratization of high-quality educational experiences in the realm of mathematics. Nevertheless, it is crucial to emphasize that the actual effectiveness of GeoGebra as a medium for learning is highly contingent upon the proficiency of educators in seamlessly integrating this technology into their existing curricular frameworks, as well as their aptitude for crafting engaging and meaningful learning activities that resonate with students. Consequently, it becomes imperative to prioritize comprehensive teacher training programs focused on the effective utilization of GeoGebra, alongside the development of pedagogical strategies that are suited to optimize its educational potential.

In summary, GeoGebra presents immense possibilities for revolutionizing the methodologies employed in the instruction and comprehension of mathematics, thus rendering the subject matter more accessible, interactive, and pertinent for learners

navigating the intricacies of this digital age. As a result, there is a pressing need for rigorous research to be conducted that examines the impact of GeoGebra on students' abilities to grasp and internalize complex mathematical concepts, thereby contributing to the existing body of knowledge in educational technology and mathematics pedagogy. This exploration will not only illuminate the potential benefits of GeoGebra but will also inform best practices for its implementation in diverse educational settings. Ultimately, such research endeavors will be instrumental in ensuring that the transformative potential of GeoGebra is fully realized in the pursuit of enhancing mathematical understanding among students.

The notion of plane figures as represented within the dynamic mathematical software known as GeoGebra holds significant educational value.

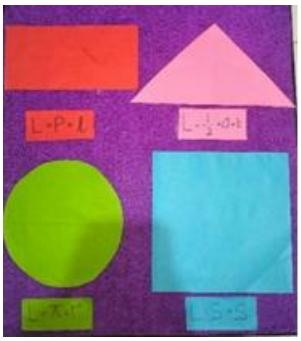
To begin with, a rectangle can be described as a two-dimensional geometric figure that is characterized by the presence of two distinct pairs of parallel sides, each pair exhibiting equal lengths. In this context, the longer sides of the rectangle are conventionally referred to as the length, denoted as (p), whereas the shorter sides are identified as the width, represented by (l). The fundamental constituents that define a rectangle encompass two pairs of parallel sides that are of equal length, four right angles positioned at each vertex, and two diagonals that intersect each other at their midpoints, thus bisecting one another. The mathematical expression utilized to calculate the area of a rectangle is represented by the formula □ = □ × □. Through the interactive capabilities offered by GeoGebra, students are afforded the opportunity to visually and dynamically explore how variations in both the length and width dimensions directly influence the overall area of the rectangle, thereby enhancing their comprehension of geometric relationships. Furthermore, a triangle is defined as a flat geometric figure that consists of three sides and three corresponding angles. Triangles can be classified into various categories based on the relative lengths of their sides as well as the measurements of their angles, such as equilateral, isosceles, and scalene triangles. Within the GeoGebra environment, students can engage in visualizing and calculating the area of a triangle, utilizing the established formula □ = 1/2 × base × height. Additionally, learners have the capability to modify the dimensions of the triangle, which allows them to observe in real-time how alterations in either the base or height dimensions impact the area of the triangle.

Moreover, a square can be described as a specific type of flat shape that possesses four sides, all of which are of equal length, and features four right angles situated at each corner. Furthermore, a square is characterized by having two diagonals that are also of equal length and intersect each other at their midpoints, effectively bisecting one another. The GeoGebra platform significantly enhances the understanding of this geometric figure by providing a visual representation of the area formula for a square, which is expressed as $L = S^2$, where S denotes the length of one side. Through the interactive manipulation of the lengths of the sides of the square, students are able to directly observe how modifications in the dimensions lead to corresponding changes in both the area and the overall shape of the square. The circle, which is widely regarded as one of the most fundamental and essential geometric shapes, can be analyzed through various key elements including radius (r), diameter (d), arc, and chord. Utilizing the features available in GeoGebra, students can learn

and apply the formula for calculating the area of a circle, denoted as $L = \pi \times r^2$, by adjusting the radius of the circle and visually monitoring how these adjustments influence the area. This innovative program empowers students to directly visualize the interrelationships between the various components of a circle, thus facilitating a deeper understanding of related concepts such as diameter, sector, and segment.

In addition to leveraging the interactive capabilities of GeoGebra, we also incorporate tangible instructional materials in the form of flat shape boards that serve to elucidate the different types of plane figures along with their corresponding area formulas. These flat shape boards will be utilized during our on-site educational activities as we engage directly with the students to elucidate the characteristics and properties of flat shapes. By employing these concrete instructional media, students are afforded the unique opportunity to not only observe but also physically interact with and experience the shapes of plane figures such as rectangles, triangles, squares, and circles, thereby enriching their learning experience and reinforcing their understanding of geometric concepts.

Figure 1. Area of Plane Figures



The utilization of concrete learning media, such as the illustrative image referenced above, possesses a significant advantage in that it is able to present information in a visually engaging manner, thereby facilitating ease of comprehension among its intended audience. Children are afforded the opportunity to directly observe the various shapes corresponding to flat figures, understand the corresponding area formulas, and engage with examples of calculations, all of which contribute to a more holistic grasp of mathematical concepts. The mere presence of visually appealing colors and shapes has been shown to markedly enhance children's interest in the process of learning, capturing their attention in a way that more abstract representations may not achieve. Nevertheless, it is imperative to acknowledge that this type of media is inherently static in nature and is confined to the specific information that has been presented within it. As a result of its low levels of interactivity, students often find themselves less actively engaged in the overall learning process, which can hinder their ability to retain and apply the information effectively.

In contrast, GeoGebra, a dynamic software tool, offers a significantly greater degree of flexibility and interactivity when compared to traditional computer-based educational software, thereby enhancing the learning experience. Students interacting with GeoGebra can directly manipulate the shapes across various layers, resize these figures as necessary, and instantaneously detect any changes in area that result from their actions. This

interactive capability empowers students to delve into a multitude of concepts with greater depth, fostering a profound understanding that is often unattainable through static media alone. Furthermore, GeoGebra allows educators and students alike to create intricate simulations and visualizations, which can include the rotation of parts of a flat plane or the manipulation of three-dimensional spatial shapes.

The fundamental distinction between these two modalities lies in their respective levels of interactivity and flexibility offered to users. While concrete learning media serve as an effective introduction to foundational concepts during the initial stages of education, GeoGebra has proven to be particularly effective in facilitating exploration and fostering a deeper understanding of those concepts over time. In an ideal educational scenario, the combination of both forms of media would yield a more comprehensive and enriched learning experience for students. For instance, a teacher might initiate the learning process by utilizing colorful posters to introduce overarching concepts, subsequently transitioning into hands-on exploration activities that leverage the capabilities of GeoGebra to deepen students' understanding and engagement.

Table 1. results of the interactive test on calculating the area of flat shapes for 3rd grade

No	**Question**	**SS**	**S**	**TS**	**STS**	**Total**
1	-	2	7	1	0	10
2	-	0	7	1	2	10
3	-	1	3	3	3	10
4	-	2	7	0	1	10
5	-	3	6	1	0	10
Total	-	6	30	6	6	50
No	**Question**	**SS**	**S**	**TS**	**STS**	**Total**
1	-	1.6	6	1.2	1.2	10
2	-	1.6	6	1.2	1.2	10
3	-	1.6	6	1.2	1.2	10
4	-	1.6	6	1.2	1.2	10
5	-	1.6	6	1.2	1.2	10
Total	-	8	30	6	6	50

Probibalitas	0.2460254
Chi Square Hitung	9.09331908
Chi Square Tabel	14.0671404

In light of the empirical findings derived from the chi-square statistical test that we meticulously performed, we are now positioned to engage in a more granular and thorough analysis that pertains to the efficacy of employing GeoGebra as a computational tool for calculating the area of various two-dimensional geometric shapes specifically for students at the third-grade level of education. The computed chi-square statistic, which amounts to 9.093, falls below the critical value referenced in statistical tables, which is set at 14.067;

this key observation suggests that the discrepancies observed in the students' responses regarding their experiences with GeoGebra do not reach a level of statistical significance. This outcome clearly indicates that there exists insufficient empirical evidence to support the assertion that students' perceptions or reactions to the utilization of GeoGebra media in the context of instruction aimed at calculating the areas of flat geometric shapes are substantially dissimilar from one another. Furthermore, these statistical results imply that there is a lack of notable difference between individual students' responses, and the variability in their feedback remains within acceptable and reasonable limits, thereby reinforcing the notion of uniformity in their experiences.

Moreover, it is pertinent to highlight that the probability value obtained, which stands at 0.246, surpasses the conventional threshold of 0.05, a significance level widely recognized in statistical analysis; this further substantiates the conclusion that there exists no statistically significant variance in the responses provided by the students. Specifically, a probability value of 0.246 suggests a 24.6% likelihood that the observed differences within the data set might simply be a result of random chance rather than a reflection of genuine disparities. Given that this probability value exceeds the 5% benchmark, we are led to uphold the null hypothesis, which posits that there are no significant differences present among the responses. In essence, while the integration of GeoGebra into the educational framework certainly aids students in grasping the material pertaining to area calculation, it is evident that their responses and perceptions of this technological media remain largely uniform and consistent.

The outcomes derived from the statistical testing reveal that, even though GeoGebra effectively assists students in accurately calculating the areas of flat geometric shapes, the responses articulated by the students do not exhibit significant variation concerning the extent of influence this digital media has on their conceptual understanding. Consequently, one may deduce that GeoGebra indeed offers reliable and consistent benefits in the educational process; however, the resultant effects do not manifest as significantly different across the student population. Thus, we can assert that the implementation of GeoGebra is characterized by a degree of stability when it comes to enhancing students' comprehension of mathematical concepts.

It is crucial to bear in mind that, despite the absence of statistically significant differences in the responses given by students, this finding should not be misconstrued as an indication of the ineffectiveness of GeoGebra; rather, on the contrary, it serves to highlight that GeoGebra yields consistent educational outcomes that bolster the learning process. Additionally, this result suggests that students do not regard GeoGebra as an ineffective pedagogical tool, but instead recognize its value in facilitating their understanding of mathematical principles.

The utilization of GeoGebra as an interactive educational tool for the purpose of calculating the area of two-dimensional geometric figures within the context of a third-grade elementary school curriculum presents a multitude of challenges and impediments that educators must navigate. Firstly, it is essential to acknowledge that the student populace exhibits a diverse range of competencies and levels of familiarity when it comes to the use of modern technological tools. Specifically, certain learners may find themselves

in situations where they lack prior experience or comfort with using electronic devices such as computers or tablets, which can subsequently create significant barriers to their ability to effectively engage with the instructional content being presented. Consequently, those students who possess less technological proficiency may experience heightened difficulties in grasping the concepts being taught, thereby exacerbating the existing digital divide that can hinder their overall academic progress. Secondly, the adequacy of educational infrastructure and the availability of technological devices frequently emerge as critical concerns that can disrupt the implementation of GeoGebra in the classroom setting. It is important to note that not every educational institution is equipped with a sufficient number of computers or tablets to ensure that each student has individual access to these vital tools, which can lead to interruptions in the learning process and a subsequent reduction in the efficacy of GeoGebra-based instruction. Furthermore, the quality and reliability of internet connectivity within certain schools may be inconsistent, thereby posing additional obstacles to the seamless integration of GeoGebra as a teaching resource. Moreover, the readiness and preparedness of educators themselves play a pivotal role in the successful deployment of GeoGebra as a pedagogical aid, as teachers may require specialized training to become proficient in utilizing this software effectively. In addition to these challenges, it is crucial to recognize that the motivation levels of students to engage with GeoGebra can vary significantly from one individual to another. This variability necessitates the development of instructional strategies that harmoniously blend interactive technological methodologies, such as those offered by GeoGebra, with more traditional educational approaches that students may find more relatable. Indeed, there exists a subset of learners who exhibit a preference for conventional modes of instruction and may exhibit a lack of enthusiasm for engaging with technological tools, which could ultimately result in their diminished participation and involvement in the overall learning experience.

D. CONCLUSION

The implementation of GeoGebra, an advanced interactive learning platform, in the context of teaching 3rd-grade elementary students about the calculation of areas pertaining to flat geometric shapes, holds remarkable promise in significantly elevating students' comprehension of abstract mathematical concepts, particularly those relating to the area of various two-dimensional figures. This innovative software not only facilitates students' active engagement with mathematical material through the utilization of visual representations but also enables them to directly manipulate geometric shapes in a way that profoundly enriches their educational experience, ultimately fostering a more profound understanding of mathematical principles. By employing this interactive methodology, students are not limited to merely memorizing formulas; instead, they are encouraged to grasp the underlying processes and methodologies that govern area calculation, leading to a deeper cognitive engagement with the subject matter.

Nonetheless, the integration of GeoGebra into educational settings is not without its challenges, as several significant obstacles must be addressed for its successful implementation. These obstacles include, but are not limited to, the disparities in

technological proficiency among students, the often insufficient technological infrastructure present within many educational institutions, and the varying levels of readiness among teachers to effectively utilize this software application in their instructional practices, which collectively represent the primary hurdles to overcome. In order to fully optimize the educational advantages offered by GeoGebra, it is imperative that comprehensive training programs for teachers are established, alongside an instructional approach that harmoniously blends traditional teaching methods with modern technological tools, thus ensuring that every student has the opportunity to actively engage in the learning process.

Research findings indicate that, while GeoGebra indeed provides substantial benefits for enhancing students' learning experiences, the responses from students regarding its use tend to exhibit a level of uniformity that does not reveal any statistically significant differences. This observation suggests that while GeoGebra maintains a consistent role in bolstering students' understanding of mathematical concepts, further modifications and refinements are necessary to fully unlock the potential of this educational tool within diverse school environments. Therefore, it can be concluded that GeoGebra serves as an effective instrument for facilitating mathematics education, especially concerning the concept of flat shapes, provided that it is underpinned by adequate technological infrastructure, comprehensive teacher training, and a pedagogical approach that is responsive to the varied needs of all students enrolled in the learning process.

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