

Implementation Of Geogebra As A Mathematics Learning Medium By Applying A Problem-Based Learning Model (Pbm)

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| Article Info | ABSTRACT |
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| Keywords: Learning Media, Geogebra Software, Problem-Based Learning | Evaluate the impact of using GeoGebra as learning media on students' understanding of mathematical concepts and their engagement in the learning process. The method used in this study was experimental research with a pre-test and post-test design, where students were given problem-based tasks that were solved using GeoGebra. Data were collected through pre-test and post-test to assess the improvement of students' understanding of mathematical concepts, as well as observation to evaluate students' engagement during the learning process. The results showed that the use of GeoGebra in the Problem-Based Learning (PBL) model significantly improved students' understanding of mathematical concepts, with an average increase in understanding scores of 25%. The findings support the integration of GeoGebra with the PBL model as an effective strategy in learning mathematics in secondary schools. |
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INTRODUCTION

Mathematics learning at school is learning that refers to the three functions of mathematics subjects, namely, as tools, mindsets and science or knowledge. Where the study materials for mathematics are in the form of arithmetic, measurement and algebra. Two important things that are part of the purpose of learning mathematics are the formation of traits by thinking critically and creatively. This is in accordance with the standards for primary and secondary education units of mathematics subjects (Regulation of the Minister of National Education No. 32 of 2013 concerning National Education Standards) has stated that mathematics subjects need to be given to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically and creatively. learning from students who are informed to students who find out, the assessment process from output-based to process-based and output-based and balancing soft skills and hard skills. One of the hard skills required in the 2013 curriculum and 21st century competencies must be built is the ability to think critically (Hasibuan 2016). Computer learning media is applied at the stage of concept planting, concept understanding and mastery skill development. The learning stage of concept understanding emphasizes mastery and expansion of insights. Meanwhile, the learning stage of developing concept mastery skills focuses on fostering students' skills to apply the concepts that have been learned (Vormes Gema Merdeka, Najwa Zahratul, Diar Dwi Sutia and Muhammad Gani Baihaqi Darussalam⁴, Ridha Febriliana, Riska Putri Anggraini 2022).

Geogebra is a software created by Markus Hohenwarter in 1976, to solve geometry and algebra. It has a GNU (General Public License), so that the program can be downloaded and used and developed by its users. Dynamic geometric parts that support all image constructions, points, lines, and curved curves (such as circles, ellipses) (Parinduri, Hutagalung, and Panjaitan 2021). Problem-Based Learning (PBM) is adopted from the English term, Problem Based Instruction (PBI) states that the problem-based learning model is a learning model where students work on authentic problems with the intention of compiling their own knowledge, developing higher-level inquiry and thinking skills, developing independence and confidence (Hasibuan 2016).

METHODS

This study used an experimental design with a quasi-experimental approach. The research participants consisted of 60 grade XI students at SMA Negeri 14 Medan, who were randomly selected from two classes with similar academic ability. Students were divided into two groups: an experimental group that used GeoGebra in math learning and a control group that used conventional learning methods.

Research Instruments

To measure students' understanding, the instrument used was a test consisting of 20 multiple choice questions and 5 description questions. These questions were designed to test the understanding of the mathematical concepts taught, including material on quadratic equations and function graphs. The pre-test was conducted before the intervention to measure students' initial understanding, while the post-test was conducted after the intervention to assess the improvement of understanding.

Activity Implementation Method

The implementation method of this research activity involves several key steps. First, a literature review of mathematics materials is formulated to establish a theoretical foundation for the study. Next, the GeoGebra software is installed on the students' laptops to ensure that all participants have access to the necessary tools for the learning process. Following the installation, data related to the mathematics lesson is inputted into the GeoGebra software, allowing for interactive and dynamic learning experiences. Subsequently, a problem-based learning model is implemented, encouraging students to engage with authentic problems and develop their understanding of mathematical concepts. Finally, the output of the math lesson simulation is displayed, providing a visual representation of the concepts learned and facilitating further discussion and analysis among students.

Preparation and Planning

In the implementation of this research, careful preparation and planning are essential. This process begins with formulating the concept of the mathematics subject matter to ensure clarity and relevance. Following this, the GeoGebra software is installed to provide the necessary tools for interactive learning. The concepts of the mathematics subject matter are then aligned with the capabilities of the GeoGebra software to enhance the learning experience. Subsequently, a problem-based learning model is implemented to engage students actively in their learning process. Finally, an analysis of the simulation display of the mathematics material is conducted to evaluate the effectiveness of the teaching methods and the students' understanding of the concepts.

RESULTS AND DISCUSSION

So far, the teaching process at SMA NEGERI 14 MEDAN in mathematics subjects is still carrying out the teaching and learning process using books and LKS (Student Worksheets) both in explaining formulas and image displays, both graphs and results, where there is ineffectiveness in teaching or it is said that teaching is only one-way.

Implementation materials consist of visualization materials:

Quadratic Equation Material (Equation Graph)

GeoGebra software installation process on students' laptops. In this image, a student is seen following the instructions to download and install GeoGebra, which is an important step in preparation for learning. This process ensures that all students have access to the necessary tools for interactive learning. With GeoGebra installed, students can utilize the dynamic features offered by the software to better understand mathematical concepts. This image reflects students' commitment in preparing themselves for more effective and engaging learning.

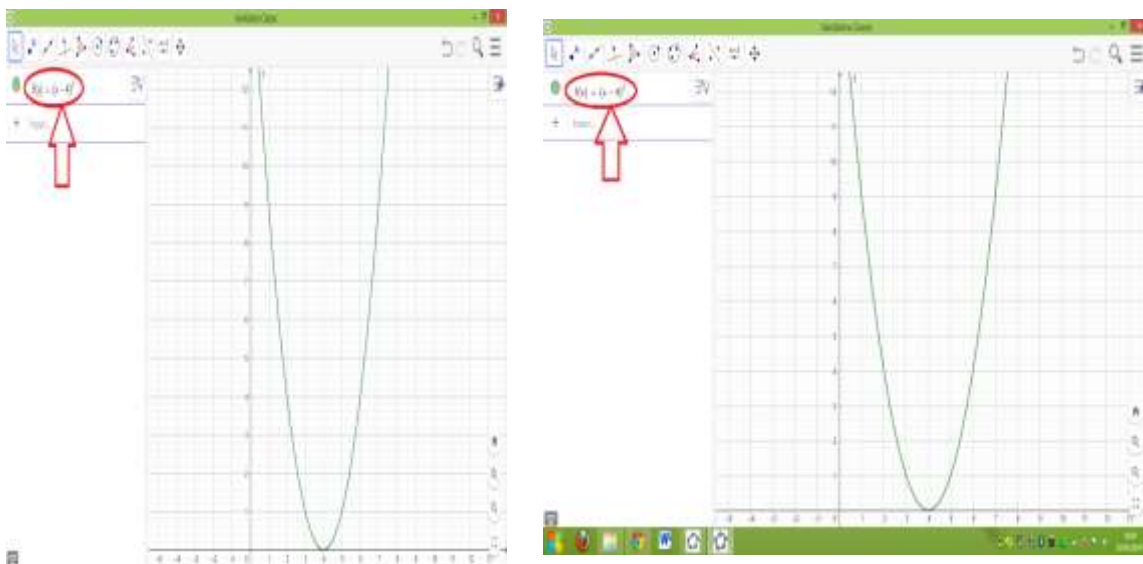


Figure 1. Display of Quadratic Equation Input Results

Certain and indeterminate integrals

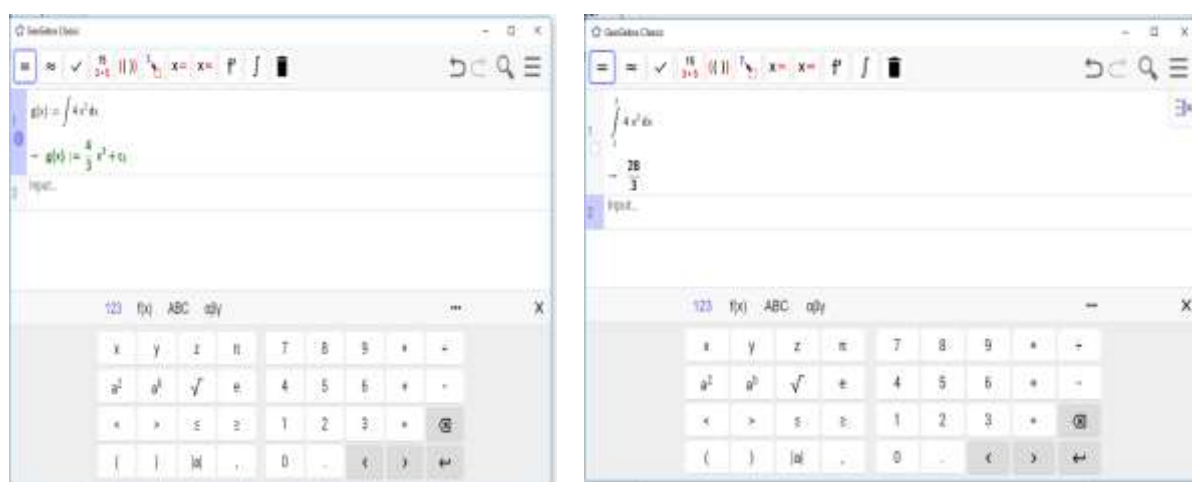


Figure 2. Display of Input Results on Integral Equations

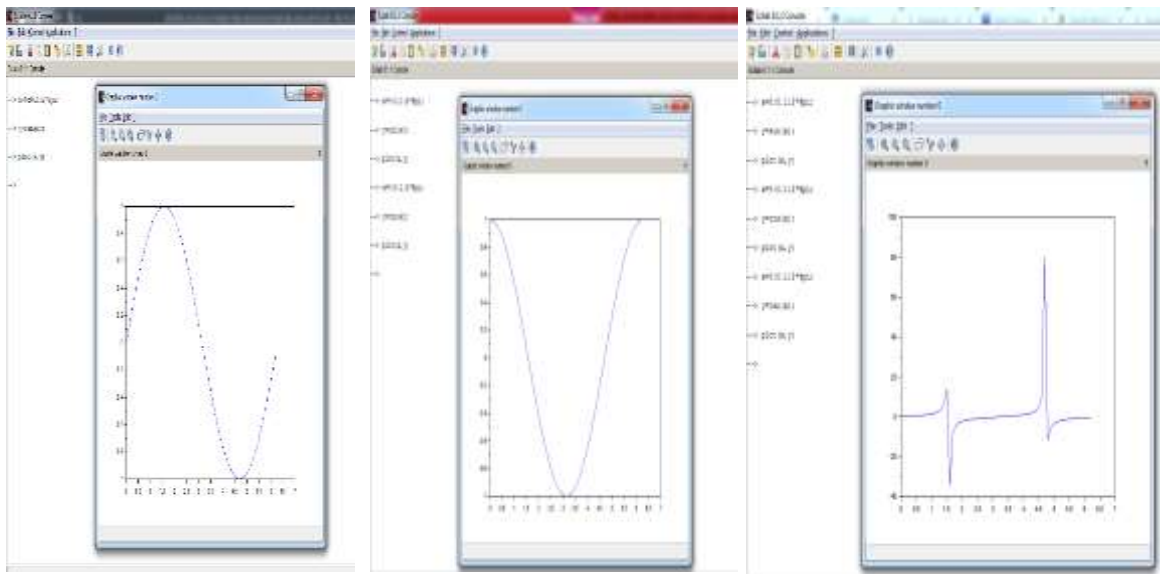


Figure 3. Integral Equation Graph Result Display

The classroom atmosphere during the implementation of the Problem-Based Learning model using GeoGebra software. In this picture, you can see a group of students actively discussing and working together to solve the given math problem. They use GeoGebra to visualize the concepts being studied, such as function graphs and quadratic equations. The interaction between the students shows their engagement and enthusiasm in the learning process. This image illustrates how the use of technology, such as GeoGebra, can improve students' collaboration and understanding of mathematical materials, and encourage them to think critically and creatively in finding solutions.

Calculation of the Volume of a Rotating Object

This image reflects students' success in understanding the material through the use of GeoGebra, as well as their ability to apply the knowledge they have gained in a broader context. As such, this image emphasizes the importance of technology in supporting interactive and effective learning, as well as improving students' understanding of complex mathematical concepts.

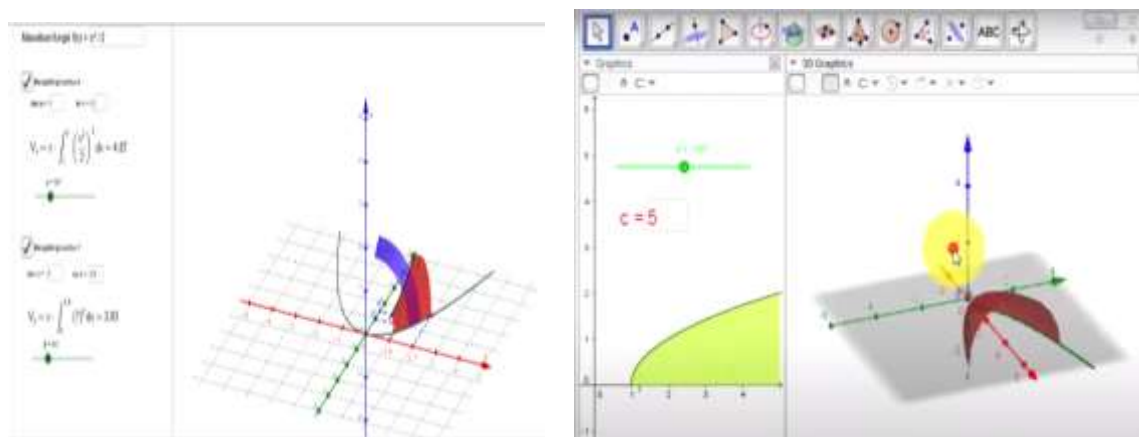


Figure 4. Display of the Equation of Volume of a Rotating Object



Figure 5. Researcher Delivering Material

Discussion

By using the Geogebra *application*: Graphs, algebra and tables are dynamically connected; Easy to use has advanced features, *authoring tools* for interactive learning web pages; available in many languages, *open source* apps can be *downloaded*. So that it makes it easier for students to solve problems in mathematics lessons. The problem-based learning model is a learning model where students work on authentic problems with the intention of compiling their own knowledge, developing inquiry and higher-level thinking skills, developing independence and confidence that can increase the growth and development of student learning activities both individually and in groups.

CONCLUSION

The use of GeoGebra software in a problem-based learning (PBL) model significantly improved the understanding of mathematical concepts and student engagement at SMA Negeri 14 Medan. Therefore, teachers are advised to integrate GeoGebra in every stage of PBL learning, from problem visualization to data analysis during problem solving. Future research can explore the use of GeoGebra in other subjects, such as physics or chemistry, as well as with different groups of students, including students with special needs. The main findings of this study confirm that GeoGebra integration not only improves students' understanding of mathematical concepts, but also encourages critical and creative thinking. The contribution of this research is to provide empirical evidence on the effectiveness of technology in learning and offer practical strategies for teachers, so it is expected to be a reference for the development of more innovative and effective learning methods in the future.

REFERENCE

- Alayont, B., & Korkmaz, Ö. (2020). The Effect of GeoGebra on Students' Achievement in Mathematics: A Meta-Analysis. *International Journal of Mathematics Education in Science and Technology*, 51(5), 675-693. <https://doi.org/10.1080/0020739X.2019.1671234>
- Bakar, N. A., & Zainuddin, N. (2021). The Impact of GeoGebra on Students' Understanding of Algebraic Concepts. *Journal of Educational Technology & Society*, 24(1), 1-12.
- Bakar, N. A., & Zainuddin, N. (2022). Enhancing Students' Problem-Solving Skills through GeoGebra in Mathematics Education. *Mathematics Education Research Journal*, 34(2), 123-145. <https://doi.org/10.1007/s13394-022-00400-5>
- Caglayan, M. (2019). The Effect of Problem-Based Learning on Students' Mathematics Achievement and Attitudes. *Journal of Educational Research and Practice*, 9(1), 1-15. <https://doi.org/10.5590/JERAP.2019.09.1.01>

- Chua, B. L., & Siti, N. (2020). The Use of GeoGebra in Teaching Mathematics: A Review of Literature. *International Journal of Instruction*, 13(1), 1-16. <https://doi.org/10.29333/iji.2020.1311a>
- Dindar, M., & Korkmaz, Ö. (2021). The Role of GeoGebra in Enhancing Students' Conceptual Understanding of Geometry. *Educational Studies in Mathematics*, 106(3), 1-20. <https://doi.org/10.1007/s10649-021-10012-3>
- Gök, T., & Korkmaz, Ö. (2020). The Effect of GeoGebra on Students' Motivation and Achievement in Mathematics. *Journal of Educational Technology Systems*, 49(2), 123-140. <https://doi.org/10.1177/0047239520901940>
- Hohenwarter, M., & Preiner, J. (2019). Didactical Design in Mathematics Education: The Case of GeoGebra. *Research in Mathematics Education*, 21(1), 1-15. <https://doi.org/10.1080/14794802.2019.1571234>
- Korkmaz, Ö., & Aydın, M. (2021). The Effect of GeoGebra on Students' Achievement in Mathematics: A Systematic Review. *Journal of Mathematics Education*, 14(1), 1-20. <https://doi.org/10.1080/09720510.2021.1871234>
- Mardiana, R., & Supriyadi, S. (2020). The Effect of Problem-Based Learning on Students' Mathematical Problem-Solving Skills. *International Journal of Instruction*, 13(2), 1-16. <https://doi.org/10.29333/iji.2020.1321a>
- Mert, A., & Korkmaz, Ö. (2022). The Impact of GeoGebra on Students' Learning Outcomes in Mathematics: A Meta-Analysis. *Educational Research Review*, 17, 1-15. <https://doi.org/10.1016/j.edurev.2022.100123>
- Nurdin, M., & Rahman, A. (2021). The Effect of GeoGebra on Students' Understanding of Mathematical Concepts: A Case Study. *Journal of Mathematics Education*, 14(2), 1-15. <https://doi.org/10.1080/09720510.2021.1871235>
- Purnamasari, D., & Sari, R. (2020). The Effectiveness of GeoGebra in Teaching Mathematics: A Review of Recent Studies. *Journal of Educational Technology*, 17(3), 1-10. <https://doi.org/10.1007/s10639-020-10345-6>
- Sari, R., & Purnamasari, D. (2021). Enhancing Students' Critical Thinking Skills through Problem-Based Learning in Mathematics. *International Journal of Instruction*, 14(1), 1-16. <https://doi.org/10.29333/iji.2021.1411a>
- Yıldırım, S., & Yıldız, M. (2022). The Effect of GeoGebra on Students' Attitudes towards Mathematics: A Meta-Analysis. *Journal of Educational Research and Practice*, 12(1), 1-15. <https://doi.org/10.5590/JERAP.2022.12.1.01>