
Develop Creativity, Imagination Ability, and Understanding of Mathematics Concepts Using Geogebra as a Virtual Learning Media By Guidebooks

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Abstrak: Kemajuan teknologi menuntut pendidik untuk meningkatkan kualitas pendidikan dan membangun lingkungan belajar yang efektif dan inovatif. Matematika sering menjadi bidang studi yang menantang bagi siswa, karena mereka berjuang untuk memahami konsep matematika abstrak. Sebagai pendidik profesional, guru harus mampu mengatasi kesulitan ini. Salah satu pendekatan untuk mengatasi tantangan ini adalah dengan menyediakan sumber belajar yang sederhana dan menarik bagi siswa. Teknologi diharapkan dapat memberikan kemudahan bagi guru dalam meningkatkan kemampuan mengajarnya. Dengan memanfaatkan Geogebra, baik guru maupun siswa dapat terlibat dalam eksplorasi visual untuk memahami konsep matematika abstrak, melakukan simulasi, dan mendekati pemecahan masalah dari berbagai sudut dengan cara yang lebih intuitif. Misalnya, siswa dapat mengeksplorasi hubungan antara fungsi linier dan grafiknya dengan menyesuaikan parameter garis. Penelitian dilakukan terhadap mahasiswa semester IV pendidikan matematika yang mengambil mata kuliah Media Pembelajaran Matematika, semester IV kurikulum 2021 Fakultas Keguruan dan Ilmu Pendidikan Program Studi Pendidikan Matematika Universitas Sebelas Maret Surakarta tahun akademik 2022/2023 yang terdiri dari 44 mahasiswa. Berdasarkan penelitian yang dilakukan, ditetapkan bahwa aplikasi Geogebra dapat meningkatkan dan mendorong perkembangan kemampuan matematika siswa. Selanjutnya, melalui visualisasi buku panduan, peneliti mengamati bahwa siswa menjadi lebih praktis, imajinatif, dan inventif dalam menjelaskan implementasi aplikasi Geogebra, khususnya dalam konteks matematika.

Kata kunci : *teknologi, media pembelajaran maya, geogebra*

Abstract: The progress of technology necessitates educators to enhance the quality of education and establish an effective and innovative learning environment. Mathematics is often a challenging field of study for students, as they struggle to comprehend abstract mathematical concepts. As professional educators, teachers must be capable of addressing these difficulties. One approach to overcoming these challenges is by providing simple and engaging learning resources for students. Technology is expected to provide convenience for teachers in improving their teaching abilities. By utilizing Geogebra, both teachers and students can engage in visual exploration to understand abstract mathematical concepts, conduct simulations, and approach problem-solving from various angles in a more intuitive manner. For instance, students can explore the relationship between a linear function and its graph by adjusting the line's parameters.

The research was conducted on students in the fourth semester of mathematics education who took the Mathematics Learning Media subject, semester IV of the 2021 curriculum of the Faculty of Teacher Training and Education, the Mathematics Education Study Program at Sebelas Maret University Surakarta for the 2022/2023 academic year which consist of 44 students. Based on the conducted research, it was determined that the Geogebra application can enhance and foster the development of students' mathematical skills. Furthermore, through the visualization of guidebooks, researchers observed that students became more practical, imaginative, and inventive in explaining the implementation of the Geogebra application, particularly in the context of mathematics.

Keywords: *Technology, virtual learning media, geogebra*

INTRODUCTION

In today's digital era, the use of information and communication technology has brought significant changes in various areas of life, including in the world of Education. The development of technology requires educators to improve the quality of education and create an effective and innovative learning atmosphere. Advances in information and communication technology have opened up new opportunities to create an exciting, interactive, and dynamic learning environment. The development of technology is not only limited to operating computers, but also utilizing them as learning aids. The learning aids in question are learning media with Information and Communication Technology (ICT) which can increase student interest in the learning process and facilitate students to take an active role in learning activities. Learning media is one of the important things that affect the success of learning. With the use of appropriate learning media, students will more easily receive and digest the information conveyed by the teacher. In line with technological developments, virtual learning is one of the uses of technology that is useful in increasing learning effectiveness, especially in mathematics subjects .

Mathematics is one of the fields of study that is often complained by students. Many students have difficulty understanding abstract mathematical concepts. As professional educators, teachers must be able to overcome difficulties experienced by students. These difficulties can be overcome by providing simple and interesting learning offerings for students. With technology, it is expected to provide convenience for teachers in improving their teaching abilities. Teachers can innovate to find the right learning media to be applied in schools. However, in reality many teachers still have difficulty using Information and Communication technology (ICT) -based learning media both for elementary, junior high, and even high school levels. According to Ghofar and Rohman & Susilo (2019), some teachers have difficulty in using ICT-based learning media because of the very short duration in class, facilities and facilities that are still minimal in classrooms to support ICT-based learning , it is difficult to condition students because it still requires more special attention so that teachers are not all ready to

use ICT-based learning media. This difficulty is a challenge for teachers to continue to find effective learning solutions. As a professional teacher, you must have the ability to find and use effective media to be developed in accordance with the material taught. The use of technology to develop learning media can be started by finding software that is appropriate and can be applied in mathematics learning.

One of the software that can be used in mathematics learning is the Geogebra application. Geogebra is a dynamic, free, and multi-application mathematical software that combines geometry, algebra, tables, graphs, statistics and calculus in one easy package that can be used for all levels of education (Tanzimah, 2019). Dynamic means that it can produce interactive mathematical applications. Free means that anyone can change and operate the program as they wish. Multi-application means that Geogebra is available for all types of computers. By using Geogebra, teachers and students can conduct visual exploration in understanding abstract mathematical concepts, making simulations, and solving problems with n approaches. which is more intuitive. For example, students can explore the relationship between a linear function and its graph by shifting the parameters of the line. Virtual learning using the Geogebra application has several advantages. According to Jahnabila & Fahlevi (2023), the presentation of the Geogebra application is interesting and easy to understand in a short time so that it is effective if used in learning mathematics. This is corroborated by Tanzimah (2019) who states that Geogebra makes it easier for students to demonstrate or visualize mathematical concepts and as a tool for constructing mathematical concepts.

Geogebra also provides various interactive features that can be used in making virtual learning media. With the interactive features in Geogebra, students can learn independently and actively with an effective approach to learning mathematics. The use of geogebra in virtual learning media can increase student involvement in the learning process. In conventional mathematics learning, students often feel bored and difficult to understand the concepts taught. However, with Geogebra students can be seen actively in the process of exploration and discovering mathematical relationships that were previously difficult to understand. In addition, students' 21st century abilities are also increasing, namely the ability to think creatively, think critically, and so on. Geogebra not only facilitates students' understanding but also enhances students' competencies. Basically, Geogebra has three uses, namely as a medium for learning mathematics, a tool for making mathematics teaching materials, and a tool in solving problems math (Agung, 2018). Through these three basic uses, teachers can present learning more effectively and interestingly. Not only limited to these three uses, the development of Geogebra application features can also be utilized in making digital classes by teachers. This research was prepared to describe the exploration of how the Geogebra application can be used in the development

of virtual learning media then students can develop their creativity, imagination, and easy to understanding of mathematics concepts using this application by guidebooks.

RESEARCH METHOD

The research approach used is a qualitative approach with the method used is descriptive. Descriptive research is research conducted to determine the existence of independent variable values, either one or more variables (independent) without making comparisons or relating them with other variables (Sugiyono, 201: 9) . Drawing and analysis is the development of innovative mathematics learning media through creative thinking skills.

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RESULTS AND DISCUSSION

From 44 students who is already submit the project, we selecting some of the best guidebook results which represent various of mathematics subjects as below :

Table 2. Material Topics for Innovative Mathematics Learning Media Design


Material	Media Name	Media Objectives	Documentation
System Of Linear Equations Of Three Variables	“Buku Panduan Geogebra : Sistem Persamaan Linier Tiga Variabel” (Guidebooks of Geogebra : System Of Linear Equations Of Three Variables) https://drive.google.com/file/d/1TEW6-0te0ycv74y4FA847CggxZFjfyLC/view?usp=sharing	1) Help students understand the concept of system of linear equations of three variables 2) Provide different and varied experience 3) Creating an interactive, creative, fun learning atmosphere, fostering attitudes and skills about educational technology use Geogebra application for system of linear equations of three variables subject.	

Figure 1. Guidebooks of Geogebra : System Of Linear Equations Of Three Variables

Circle Equation

“Buku Panduan Penggunaan ‘Medplin’ (Media Pembelajaran Persamaan Lingkaran) Kelas XI Matematika Peminatan”

Guidebooks for Using ‘Medplin’ (Learning Media for Circle Equation) for Senior High School Students

https://drive.google.com/file/d/1vsUxZ94H45VoUP8GebTbqEal3_OJazKW/view?usp=sharing

- 1) Help students understand the concept of circle equation
- 2) Provide different and varied experience
- 3) Creating an interactive, creative, fun learning atmosphere, fostering attitudes and skills about educational technology use Geogebra application for circle equation subject.



Figure 2. Guidebooks for Using ‘Medplin’ (Learning Media for Circle Equation) for Senior High School Students

Function

“Buku Panduan Media Pembelajaran Maya : Materi Fungsi Kelas X SMA”

Guidebooks of Virtual Learning Media : Function Subject for Senior High School

https://drive.google.com/file/d/1igMxH20KH_kLb6GDROnLtNDndnrMR-XA/view?usp=sharing

- 1) Help students understand the function especially for senior high school students
- 2) Provide different and varied experience
- 3) Creating an interactive, creative, fun learning atmosphere, fostering attitudes and skills about educational technology use Geogebra application for mathematics function subject.



Figure 3. Guidebooks of Virtual Learning Media : Function Subject for Senior High School

Ratio of Trigonometri and Related Angel

Buku Panduan Media Pembelajaran Geogebra Untuk Materi Rasio Trigonometri dan Sudut Berelasi Kelas X SMA

Guidebooks of Virtual Learning Media for Ratio of Trigonometry and Related Angel for Senior High School

https://drive.google.com/file/d/1igMxH20KH_kLb6GDRQnLtNDndnrMR-XA/view?usp=sharing

- 1) Help students understand the ratio of trigonometry for senior high school students
- 2) Provide different and varied experience
- 3) Creating an interactive, creative, fun learning atmosphere, fostering attitudes and skills about educational technology use Geogebra application for ratio of trigonometry subject.



Figure 4. Guidebooks of Virtual Learning Media for Ratio of Trigonometry and Related Angel for Senior High School

Geometry

“Buku Pedoman : Geogebra Untuk Bangun Ruang”

Guidebooks : Geogebra for Geometry

<https://drive.google.com/file/d/1g8-GTdwiY6oFMi3r3xZkclQJJB2LxN0t/view?usp=sharing>

- 1) Help students understand the geometry for senior high school students
- 2) Provide different and varied experience
- 3) Creating an interactive, creative, fun learning atmosphere, fostering attitudes and skills about educational technology use Geogebra application for geometry subject.



Figure 5. Guidebooks : Geogebra for Geometry

The results of student understanding as outlined in the form of guidebooks, each of which discusses the use of Geogebra in different materials, show that through this media students are able to be more active and creative to show how the application can be used in a more fun way.

Fun learning, especially in subjects that are considered difficult such as mathematics can increase the possibility of the material being understood and optimal in its use, such as the results of research conducted by Hadi, et al (2018) on students of SMK Negeri 2 Palembang which shows that mathematics learning outcomes using this application can improve students' mathematics learning outcomes and help them understand mathematical concepts in the learning process. In addition, the use of Geogebra can also help students understand mathematical concepts in depth through visual representation (Aminudin, et al., 2021), having a positive impact on students' mathematical logical thinking skills (Fauzan, et al., 2020). Improve mathematical communication skills, understanding of mathematical concepts, mathematical reasoning, mathematical problem solving, and mathematical connection skills (Suciati, et al., 2022).

With the guidebook that has been designed by students with various variations of material, it is hoped that it can expand the understanding of the use of the Geogebra application, especially in learning activities so that the application of mathematics becomes wider in scope and useful.

CONCLUSIONS AND SUGGESTIONS

From the research that has been done, researchers concluded that the development of students' mathematical abilities can be improved and developed through the use of the Geogebra application. In addition, by pouring ideas in the form of visualization of guidebooks, researchers found that students became more concrete, creative, and innovative in conveying how to implement the Geogebra application, especially in mathematics subjects which hopefully will facilitate and make readers happy when they will use the application. Suggestion to lecturers and students especially those who are engaged in mathematics to be able to get to know and learn more about Geogebra so that in the future learning will be more fun, effective, and maximal in its implementation

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