



## Utilization of Geogebra Learning Media to Improve Fifth Grade Students' Understanding of Mathematics

Rudi Ruhardi <sup>a,1\*</sup>, Eka Danik Prahastiwi <sup>a,2</sup>

<sup>a</sup> Institut Studi Islam Muhammadiyah Pacitan

<sup>1</sup> rudiruhardi@isimu.ac.id\*; <sup>2</sup> prahastiwidanik@isimu.ac.id;

\* eka danik prahastiwi

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### Abstract

*The purpose of this research is to create a learning media for the concept of geogebra to improve students' mathematical understanding of the material of spatial structure. The things tested in this study were validity, practicality, and effectiveness. This research method is R&D with a 4-D model, namely defining, designing, developing and distributing. However, in this study only up to the development stage. Based on the research that has been done, the result is that the average score of media experts is 3.6, material experts are 3.6, which means the results are very good. Furthermore, the practicality score obtained from the teacher's response questionnaire is 89,93% and the student's is 78,67%. Furthermore, the results of the effectiveness of learning media get 90% of students who get complete learning using geogebra learning media*

### Abstrak

Penelitian ini bertujuan untuk membuat media pembelajaran konsep Geogebra guna meningkatkan pemahaman matematika siswa terhadap materi struktur spasial. Hal-hal yang diuji dalam penelitian ini adalah validitas, praktikalitas, dan efektivitas. Metode penelitian ini menggunakan model R&D dengan model 4-D, yaitu pendefinisian, perancangan, pengembangan, dan penyebaran. Namun, dalam penelitian ini hanya mencapai tahap pengembangan. Berdasarkan hasil penelitian yang telah dilakukan, rata-rata skor dari ahli media adalah 3,6, ahli materi adalah 3,6, yang berarti hasilnya sangat baik. Selanjutnya, skor praktikalitas yang diperoleh dari kuesioner tanggapan guru adalah 89,93%, dan tanggapan siswa adalah 78,67%. Selanjutnya, hasil efektivitas media pembelajaran mendapatkan 90% siswa yang berhasil memahami pembelajaran menggunakan media pembelajaran Geogebra.

## INTRODUCTION

Education is a way to produce a generation of superior and quality nations. States that education is a means to improve all aspects of life, including technology, social, economic, cultural, and noble character (Ilham, 2019). In order to achieve the goals of education, therefore, to achieve these goals, efforts are needed to improve the quality of quality education by following the progress of the times (Prahastiwi, 2023; Putu et al., 2023)

In the world of education in schools, it contains lessons that are very useful for student development, one of which is mathematics. Mathematics is an exact science that plays an

important role in everyday life. Mathematics is the science of logic in recognizing shapes, arrangements, quantities, and concepts related to one another (Sylviani & Permana, 2019). Thus, each individual must master mathematics because it is directly related to everyday life. One way to master mathematics is to understand the understanding of concepts.

Diana states that understanding concepts is one of the most important aspects in learning mathematics, which has the same goal as one of the goals of education (Diana et al., 2020). She researched that external factors influence the understanding of mathematics, including learning methods, models, and strategies. Dewi states that every human being has the ability to receive and interpret knowledge that has been generalized from a phenomenon (Dewi & Ibrahim, 2019). So understanding the concept is a very important concept of learning mathematics in mathematics and must be understood by all students because understanding the concept is the foundation for doing mathematics.

Based on the opinion of Atmaja said that a number of students had difficulty in doing mathematics because they did not master the understanding of mathematical concepts (Atmaja, 2021). The cause of students who do not like mathematics is because mathematics is considered complicated and difficult, even though mathematics will be easy if you can understand mathematical concepts in the lesson so that learning outcomes have not been achieved optimally, for example in the subject matter of building cubes and blocks. Actually, there are many learning methods that can be used to improve students' understanding of concepts, but here researchers use student aids in the form of learning media (Asrori et al., 2023; Buntoro et al., 2024).

Mathematics learning media can help introduce unique ideas into basic ideas by including pictures, recordings, sounds, and movements (Tristia & Mahardhani, 2023). In the application of learning, there are various types of learning media. Researchers use geogebra because geogebra is the most relevant software in its application to the subject matter of properties and nets of cubes and cuboids, because geogebra is able to display visuals that are useful for displaying spatial concepts in 3 dimensions. This is very useful to help learning and can improve students' understanding of concepts. Geogebra's capacity as a learning medium that provides visual display to students so that students can communicate with mathematical ideas (Elvi et al., 2021). A previous study that discussed geogebra was Yanti entitled "Application of Geogebra Assisted Scientific Approach in Efforts to Improve Students' Understanding of Mathematical Concepts". The result of this research is that geogebra learning media can produce students' understanding of mathematical concepts with a scientific approach (Yanti et al., 2019). In another study related to geogebra, Lestari entitled "Development of Mathematics Teaching Materials by Utilizing Geogebra to Improve Concept Understanding". The result of the research is that geogebra can improve students' understanding of concepts through interactive geogebra learning media in the implementation of learning. In addition, geogebra is also more fun because of the attractive media display as well as training students to be more independent and think creatively in learning (I. Lestari, 2018).

From the two research explanations above, it can be concluded that learning media has the potential to lead to active and independent learning in learning mathematics. Thus, the purpose of this research is to develop learning media that have been tested for validity, practicality, and effectiveness, which aims to improve the ability to understand mathematical concepts of fifth grade students in the material properties and nets of cubes and blocks.

## **LITERATUR REVIEW**

### **Education**

Education is a crucial aspect that every individual should undergo throughout their lifetime, and it will continue to evolve with the changes in time. Education, in its broad sense, has been practiced since the existence of humanity in the world. With the development of human civilization, the content and form of education have also evolved. Similarly, its implementation has progressed in line with the advancement of human thoughts and ideas about education. Education is a vital element in advancing global development and civilization (Danik & Superi, 2022). Mathematics plays a crucial role in elementary education, serving as a foundation for a child's overall academic development and everyday life skills. The early introduction and understanding of mathematical concepts are essential for several reasons, including cognitive development, problem-solving abilities, and practical applications. This article explores the significance of mathematics in elementary education, key concepts introduced at this stage, and effective teaching strategies.

### **Geogebra**

GeoGebra is one of the dynamic mathematics programs designed for learning and teaching mathematics in schools. It was developed by Markus Hohenwarter (Saputra & Fahrizal, 2019). According to Faradisa, GeoGebra is a computer program specifically designed for teaching mathematics, particularly geometry and algebra (Faradisa, 2019). This program is freely available and can be downloaded from [www.GeoGebra.org](http://www.GeoGebra.org). GeoGebra complements the list of existing mathematics learning programs such as Maple, Mupad, and Derive. It also expands the repertoire of computer programs in the field of geometry, alongside CABRI, Geometry's Sketchpad, WinGeom, or others. According to Hohenwarter, GeoGebra is designed to teach geometry, algebra, statistics, and calculus simultaneously. Utilization of the GeoGebra program provides several advantages, including the following (Faradisa, 2019):

- 1) Geometry drawings produced using GeoGebra are more precise and faster compared to manual methods (using pencils, rulers, or compasses).
- 2) The animation and manipulation features in GeoGebra can offer a clearer visual experience.
- 3) It can be utilized as an evaluation tool to ensure the correctness of the created drawings.
- 4) Facilitates teachers/students in investigating or demonstrating the properties that apply to a specific geometric object.

## **METHOD**

This research uses Research and Development (R&D) research methods. R&D research method is a research method used to produce products and test the validity, practicality, and effectiveness of a product (Pahleviannur et al., 2022; Sugiyono, 2018). The steps of this study are based on the Four-D (4-D) developed by Thiagarajan. The 4-D model has four main stages of Thiagarajan (Mursal et al., 2020), namely: definition, design, development, and dissemination, in this new research at the development stage.

In this study, the instruments studied were: 1) media expert validation questionnaire, 2) material expert validation, 3) student response, 4) teacher response, and 5) student concept understanding test. This research was conducted at the MI Tholabiyah Gaji school in class V. The sample used in this study amounted to 10 people as representatives of the population (Winarto, 2018). Furthermore, the analysis is carried out, namely qualitative and descriptive quantitative analysis to obtain the results of validity, practicality, and effectiveness.

## RESULT AND DISCUSSION

### Result

After carrying out research and development, the results obtained are in accordance with the stages of the 4-D model. The first step is the definition stage, the results of the research are in the form of observations in schools related to learning activities and problems in class V on the subject of building space, learning media used by classroom teachers, as well as studies of relevant theories from journals and articles. After everything is collected, conclusions are drawn to solve the problems being studied. The second step is the design stage. In this step, the researcher conducts a design from the results of the previous analysis, the design is in the form of a solution design that will be researched and developed in accordance with the flat material for grade 5. In the design of this learning media, there are several components, namely: 1) Core Competencies (*KI*) and Basic Competencies (*KD*), 2) Profile 3) Learning objectives, 4) the properties of the cube space, 5) the properties of the beam space, 6) the nets. cube space, 7) the nets of building block spaces.

When the learning media is started, it will display picture 1. The initial display of the media is in the form of the material title "Properties And Nets (Beams And Cube)". In this menu there are 3 buttons, namely properties of building space which is useful for viewing material properties. the nature of building space, nets of bangun range which is useful for viewing the material for constructing space nets, and about materials and authors to see the display of subject names, Core Competencies (*KI*) and Basic Competencies (*KD*), author's identity, and the purpose of making learning media. On the menu button is a button to return to the main menu.

In the Properties menu, two options will appear, namely the properties of the cube and the properties of the beam. In the cube properties menu, there are 6 subject matter, namely 1) corner points, 2) ribs, 3) plane/side, 4) diagonal plane/side, 5) space diagonal, 6) diagonal plane. In addition, there is also a picture of a cube space. In one of the choices of material for displaying the properties of the cube, there is a diagonal field, in the menu it describes several options and pictures of the diagonal space in the cube space. To display the material by clicking on one of the elements of the space so that an image will appear from one of the diagonal areas of the space. On the spatial grid menu, there are two choices, namely cubes and blocks. On the cube grids menu, there is a choice of spatial grids, if you click the tick, the cube will appear.

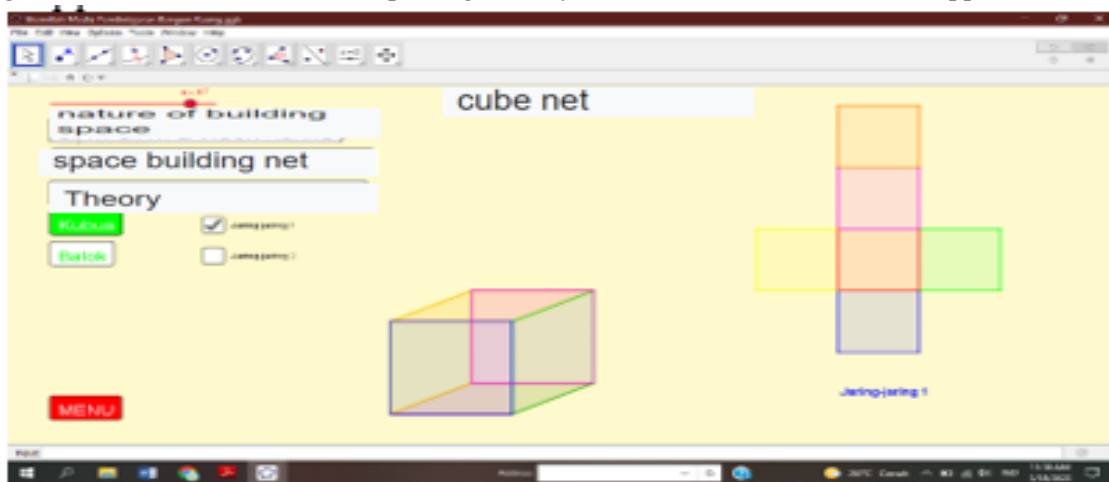


Figure 1. Design Display of Cube Nets

From the design of this learning media, it will be implemented on the *geogebra.org* website so that it can be accessed by anyone and anywhere using a computer or smartphone. Then the next step is testing the validity, practicality, and effectiveness.

Learning media products are of high quality based on Nieveen (Ardani et al., 2023) if they meet 3 aspects, namely 1) validity, 2) practicality, 3) effectiveness. The first stage in testing the quality of learning media is to test the validity. The validity test was carried out by testing the learning media products to 2 material experts and 2 media experts. For the results of the material expert 1, a score of 43 out of 48 total scores was obtained and the results from the material expert 2 obtained a score of 44 out of 48 total scores. From the two material experts, an average of 43.5 out of 48 total scores or 90.625% was obtained. These results are included in the category of very valid criteria, and there are several revisions from material experts as well. For the results of media expert 1, it was obtained a score of 68 out of 76 total scores and media expert 2 got a score of 69 out of 76 total scores. So the average is 68.5 out of 76 total scores or 90.13%. These results are included in the very valid category, and several revisions from media experts to be developed for the better.

The next step is to calculate the practicality value by calculating the results of the teacher's response to the fifth grade teacher and the fifth grade's student response with a limited scale trial. Data was taken using a questionnaire. The result is that the teacher response score is 89.93% and the student response is 78.67%. These results indicate that the learning media products are included in the good category. Based on these data, it shows that teachers and students are practical in using these learning media.

The next step is to assess the effectiveness of the learning media. The value of effectiveness is obtained by giving mathematical questions about the properties and nets of cubes and blocks in accordance with the indicators of understanding mathematical concepts. The indicators for understanding mathematical concepts based on Rahayu, namely 1) the ability to identify examples and not examples of concepts, 2) the ability to clarify objects according to certain properties according to the concept, 3) the ability to present concepts (Rahayu & Pujiastuti, 2018). From the question of understanding the concept based on the indicators of understanding the concept, the following results were obtained.

**Table 1.** Concept Understanding Test Results

No	Results	Value
1.	Mean	77,8
2.	Completed student	8
3.	Unfinished students	2
4.	Percentage	80%

Based on table 1, the results of the concept understanding ability test in the limited trial class showed an average value of 79.8 and the percentage of completeness results was 90%. Based on these results, the results of the effectiveness test showed very high results. From the three tests above, namely the validity, practicality, and effectiveness tests, it shows that the *geogebra* learning media has fulfilled all the aspects that have been determined.

### **Discussion**

The *geogebra* learning media managed to get good scores in the validity, practicality, and effectiveness tests because the *geogebra* learning media presented interesting and systematic material according to the subject, so the results could improve students' understanding of concepts. This *geogebra* learning media has been successfully implemented in information and communication technology (ICT) because it uses *geogebra* software. In the implementation of learning using this learning media, students can study in groups or individually, so that students

can define and analyze the properties and nets of cubes and blocks, this is because learning is centered on student activity in learning., so that students' conceptual understanding skills increase and student learning outcomes are also better than before. This is in line with Lestari's opinion which says that student-centered learning can improve learning outcomes (D. Lestari et al., 2019).

Geogebra learning media was developed based on the 2013 curriculum, namely the scientific approach. The scientific approach is a learning approach that refers to scientific learning methods that invite students to be active, creative, and innovative in learning. Then, this geogebra learning media includes knowledge that becomes a means for students in learning activities (reading, observing, trying, doing questions, answering questions) (Sukmawati, 2021). Thus, this learning media is very relevant if used in the current independent curriculum.

Rahayu states that the indicators of concept understanding are: 1) the ability to identify examples and non-examples of concepts, in this geogebra learning media contains the properties of spatial structures and geometrical networks that directly identify examples and not examples of concepts, 2) the ability to clarify objects according to certain properties according to the concept, in this indicator the geogebra learning media accommodates subject matter in detail and accurately according to basic competencies and learning indicators, 3) the ability to present concepts, the third indicator has also been accommodated in the media Geogebra learning is more precise in learning materials and their presentation in accordance with the subject matter (Rahayu & Pujiastuti, 2018).

This research and development is in line with Jamaluddin's research entitled, "Development of Geogebra-Based Teaching Materials on Geometric Transformation Materials on Concept Understanding of Class IX Students of SMP Negeri 1 Mangarabombang Kab. Takalar", the result of which is that the application of geogebra can improve students' understanding of mathematical concepts in geometry material (Jamaluddin, 2019). In addition, Pertiwi's research entitled, "The Application of Geogebra-Assisted Problem Based Learning Models Improves Mathematics Learning Outcomes", resulted in research stating that the geogebra application was able to improve understanding of concepts and student learning outcomes. In both studies, the results of the research both state that learning media can improve understanding of mathematical concepts (Pertiwi, 2018).

This learning media has advantages and disadvantages. as for the advantages, namely: 1) geogebra learning media is able to be a learning media facility that is easy to use by teachers and students in teaching and learning activities, 2) this learning media can be accessed online on the geogebra.org website so that it can be used anywhere and anytime using a computer and smartphones, 3) this learning media is able to improve students' conceptual understanding skills because they are able to display images systematically and accurately, 4) in accordance with basic competencies and learning indicators in the mathematics subject of the chapter on properties and spatial networks. The drawbacks are 1) this geogebra learning media cannot display evaluation questions because there are no supporting features for making questions in this geogebra software, 2) the material studied only focuses on the material properties and nets for class V classrooms, 3) media developed only on a narrow scale.

## **CONCLUSION**

The research that has been developed states that the geogebra learning media in spatial material can be used in classroom learning and can improve understanding of fifth grade students' concepts because it contains validity, practicality, and effectiveness. Besides that, this learning media is also able to support mathematics learning in the classroom and outside the

classroom, both using computers and using smartphones so that it is in accordance with the demands of today's independent curriculum learning.

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