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Development of Learning Media Uses Geogebra Application with Basket ball Context on Square Function Material

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Abstract. *The research is aimed at developing mathematical learning media with the help of the GeoGebra Application with basket ball context on square function material that tests its validity and practicality. This research uses the development research method with ADDIE design, but developed in this research is the GeoGebra Application to square function Materials with basket ball context. Participants in to see this validation by 2 experts and 8 high school students in Cianjur district. Research procedures include analysis, design, development, implementation and evaluation. The instruments used are validation sheets and practicality. Based on the results of the research showed that the application of GeoGebra with basket ball context on the square function material of the validator results is good and validated and practical at the time students use it.*

Keywords*: Basket ball, Geogebra Application, Square Function.*

1. INTRODUCTION

Square function material is one of the materials that must be mastered by students. Square function are considered quite abstract material because it requires a fairly high mathematical understanding of students. Mathematical understanding is important for students. This is in accordance with Santrock's opinion that concept understanding is the key to learning. Likewise, mathematical understanding is the foundation for thinking in solving mathematical problems and real life problems such as communication skills, problem solving skills, reasoning, connections, representation, critical and creative thinking. However, there are difficulties that must be experienced by students. [1] stated that concept understanding that is not strong will interfere with students' skills in using mathematical knowledge in new situations. In addition, [2] mentioned that students are often hampered in applying effective strategies when solving math problems. Furthermore, [3] emphasized that mathematics anxiety can reduce student performance by interfering with important thinking processes. [4] also found that problems in understanding math story problems are often associated with poor literacy skills.

Students' difficulty in learning Square function material is often due to its abstract nature, which makes understanding this concept challenging. The lack of adequate visualization hinders students' ability to connect mathematical concepts with their

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practical applications, thus reducing students' understanding and interest in learning more. According to [5] if the difficulties that arise do not receive immediate attention and follow-up, it will have a negative impact on students. Given that in mathematics, the material that has been given will be interrelated and mutually supportive for the next material. This is evidenced by research that reveals that the use of visual tools and interactive technology can significantly improve students' understanding of the concept of Square function [6]. Study results also indicate that the integration of visual representations in mathematics teaching assists students in developing a deeper and more meaningful understanding [7,8] Furthermore, visualization helps to address the link between theory and real applications, which is crucial in effective mathematics learning [9,10].

Learning media is one of the supporting factors that can improve student interest and learning outcomes. Along with the development of information technology (IT), there are many IT-based learning media offered. Interactive multimedia is one of the alternative learning media that teachers can use. Interactive multimedia is media that is equipped with a controller and can be operated by the user, sothat the user can choose what is desired for the next process [11].

The use of interactive multimedia will give students a different experience. With the help of interactive multimedia, students can interact with learning materials, whether with teacher assistance or not. Interactive multimedia creates student-centered learning, and is able to increase student learning independence [12]. For this reason, it is necessary to develop interactive multimedia that is suitable for use in learning, especially for mathematics learners. Geogebra is one of the software used in the development of these two interactive multimedia. Geogebra is a dynamic math software that can be used in learning mathematics, especially geometry, algebra, and calculus [13]. Geogebra can be used to make mathematical concepts dynamic [14].

Using GeoGebra software can improve mathematical abilities. and students' understanding of mathematical concepts increases by implementing learning based on interactive electronic books assisted by GeoGebra, [15]. The novelty in this development is to design and develop *Geogebra* applications on Square function material with the

context of basketball games as a supporting facility for mathematics learning at Al - Ikhlas IT High School.

2. MATERIALS AND METHODS

The method used in this research is the development research method (*Research and development).* According to [16], the development research method is a stage to develop and validate educational products. The stages passed are needs analysis, planning, development, evaluation, and evaluation to produce effective and valid products. In the development research method used refers to the development stages of the ADDIE model. The product developed is the *GeoGebra* Application as a student worksheet. The stages carried out for this research are as follows:

a. Analyze

This stage collects and analyzes information about problems, student needs in the learning process. Characteristics of students and teaching materials used. As well as analyzing the core competencies and basic competencies in the 2013 curriculum.

b. Design

This stage includes the preparation of material, sketching material that can be made in *GeoGebra*, making the initial stage of *GeoGebra* learning media and collecting materials needed in the development of *GeoGebra* applications.

c. Development

This stage focuses on preparing learning media using the *GeoGebra* application and assessing aspects of presentation feasibility, instructional design criteria, technical quality, media display and communication indicators by experts. As well as improvements and implementation of suggestions given by experts.

d. Implementation

This stage is carried out directly into the field to implement the results of the previous three stages that have been assessed by experts.

e. Evaluation

This stage is a form of drawing conclusions from the existing results after research into the field. There are several advantages and disadvantages for evaluation

for further research.

The development was carried out starting from designing the GeoGebra Application on October 03, 2023 until the GeoGebra Application trial was carried out on November 06, 2023. The limited trial subjects consisted of 8 high school students who were randomly selected. The instruments used are the GeoGebra Application validation instrument and the GeoGebra Application practicality instrument in the form of a questionnaire. The validation sheet questionnaire was filled in by expert validators to determine the validity of the GeoGebra Application in the aspects of presentation feasibility, instructional design criteria, technical quality, media display and communication indicators.

3. RESULTS AND DISCUSSION

The results of the development of the *GeoGebra Application* which contains Square function material for class X SMA which aims to determine the results of its validity and practicality. The results of the development of the *GeoGebra Application* from each stage are as follows:

a) Analyze Stage

The analysis stage is the first step carried out by literature study and field study. This activity aims to collect and analyze information obtained about the problems and needs of students in the current learning process, namely in terms of learning mathematics, especially on Square function material, student characteristics during the learning process, and teaching materials used. Field studies were conducted by interviewing one of the teachers at the school and analyzing the core competencies and basic competencies in the high school curriculum for Square function material:

Table 1. Core Competencies of 2013 Curriculum Grade 10 Mathematics

CORE COMPETENCY 3 (KNOWLEDGE)	CORE COMPETENCY 4 (SKILLS)
Understand, apply, and analyze factual, conceptual, procedural knowledge based on his curiosity about science, technology,	Processing, reasoning, and presenting in the concrete and abstract domains related to the development of what is learned at school

arts, culture, and humanities with insights into humanity, nationality, state, and civilization related to the causes of phenomena and events, and apply procedural knowledge in specific fields of study in accordance with his talents and interests to solve problems.	independently, and able to use methods according to scientific principles.

Table 2. Basic Competencies of Curriculum 2013 Grade 10 Mathematics

BASIC COMPETENCIES	BASIC COMPETENCIES
3.4 Explain and determine the solution of two-variable inequality systems (linear-square and quadratic-square)	4.4 Present and solve problems related to two-variable inequality systems (linear-square and quadratic-square)

b) Design Stage

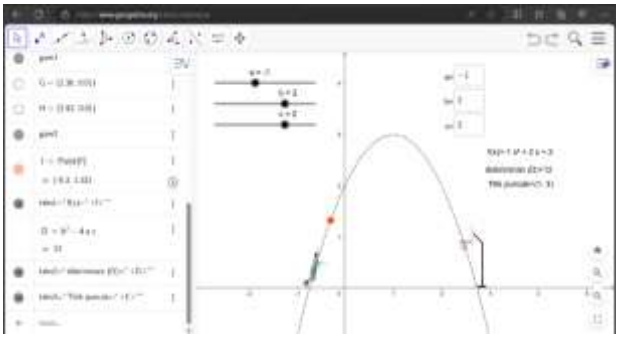
At this stage, an investigation of students' difficulties in learning Square functions is carried out, most students have difficulty in graphing Square functions, it can be caused by several reasons such as the failure of making graphs due to lack of precision and incorrect lines when making them manually and some students find it difficult to accept material related to function material and graph changes in certain circumstances.

Visualization of Square function shapes is essential in facilitating students' understanding of this complex mathematical concept. By using graphs and other visual tools, students can see how changes in coefficients affect the shape of the parabola, which helps them connect algebraic concepts with their geometric representations [7]. Learning media using the *Geogebra* application is designed as simple as possible to make it easier for students to use. In addition, this learning media uses the context of a familiar basketball game in students' lives to facilitate contextual understanding in this Square function material. The results of the

preparation of material and the design of this *GeoGebra* Application contain the title, basketball context, graph variable slides and worksheets to make it easier to identify student understanding related to visualization of Square function graphs for students.

The use of technology such as *geogebra* allows for dynamic exploration that can improve conceptual understanding and student engagement [9]. Studies also show that visual representations can strengthen students' analytical skills and facilitate understanding of the properties of Square functions [10].

Here is Figure 1, an image of the learning media for Square function material using the context of a basketball game:



c) Development Stage

The GeoGebra application that has been designed and saved in document format, then developed by entering animations, *backgrounds*, and images related to the explanation of Square function material:

Table 3. *GeoGebra* Application Suggestions and Improvements

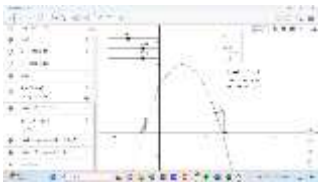
Image		**Suggestions and Improvements**
Before Revision	**After Revision**	
		Added Peak and Discriminant point values

Table 4. GeoGebra Suggestions and Improvements

Image		**Suggestions and Improvements**
Before Revision	**After Revision**	
		The media designed is very good. However, it would be better if the instructional text is tidied up, such as adding a frame to make it more pleasing to the eye and adding discriminants so that students can know how the graph of the Square function is when the discriminant is equal to, less or more than zero.

The validation sheet that has been filled in by the validator, then analyzed to determine the level of validity criteria of the GeoGebra Application developed. Data on the validation results of the *GeoGebra Application* from the assessment of each validator are presented in *Table 5*

Table 5. *GeoGebra* Application Validation Results of each Validator on the Presentation Feasibility Aspect Using a *Guttman* Scale

Validator	**Empirical Score**	**Maximum Score**	**Average Percentage Validity of Each Validator**	**Validity Criteria**
Validator 1	68	75	90,7%	Very Valid
Validator 2	71	75	94,7%	Very Valid
Average Combined Percentage			92,7%	Very Valid

Based on *Table 6, it is* known that the results of the validation of the GeoGebra Application on the presentation feasibility aspect obtained an average combined percentage of the two validators of 92.7% with the criteria "Very valid". This proves that the GeoGebra Application developed has been prepared in accordance with the format and components that must exist in a *GeoGebra* Application teaching material packaged in electronic form. While the *GeoGebra* Application validation results for each validator using *Likert* scale measurements are presented in *Table 6* below.

Table 6. Validation of GeoGebra Application of Each Validator on Aspects of

Validator	Empirical Score	Maximum Score	Average Percentage Validity of Each Validator	Validity Criteria
Validator 1	68	75	90,7%	Very Valid
Validator 2	71	75	94,7%	Very Valid
Average Combined Percentage			92,7%	Very Valid

Presentation Feasibility, Instructional Design Criteria, Technical Quality, Media Display and Communication Indicators Using a *Likert* Scale

In *Table 6* above, the results of the validation of the *GeoGebra* Application on aspects of presentation feasibility, instructional design criteria, technical quality, media display and communication indicators using *Likert* scale measurements from the six validators obtained an average combined percentage of 92.7% with the criteria "Very valid".

d) Implementation Stage

After the developed *GeoGebra* Application has been tested for validity and revisions have been made according to the validator's suggestions, then further at the implementation stage, the *GeoGebra* Application is carried out a limited trial in a small group consisting of 8 high school students.

The trial activities began by teaching students to operate several formulas on the Square function curve and explaining the activities and components contained in the Square function curve. Furthermore, inviting students to do some learning activities presented in the *PowerPoint*, including working on problems in the *GeoGebra* Application and trying to operate *GeoGebra*, as shown in *Figure 2* below:

Students Operate and Perform Activities on the *GeoGebra* Application

At the end, students were given a student response questionnaire. The assessment on the student response questionnaire, then analyzed to find out the data on the results of the practicality of the *GeoGebra* Application in the form of a combined *percentage* average of 8 students as well as the practicality criteria, which are presented in *Table 7.*

Table 8. Data on *GeoGebra* Application Practicality Results

Practicality Aspect	**Number of Student Responses**	**Maximum Score**	**Average**	**Criteria**
Showing excitement about math and seriousness in participating in learning	130	160	81,25%	Practical
Showing excitement and enthusiasm for GeoGebra-based math learning	263	320	82,19%	Practical
Showing ease on Square Function Material with the help of GeoGebra	85	120	70,8%	Practical enough
Total	478	600	79.67%	Practical

So it is known that the average student who shows a feeling of pleasure in mathematics and seriousness in participating in the lesson is 81.25.%with the criteria "Practical". Then the average student who shows feelings of pleasure and enthusiasm for this *GeoGebra-based* math learning is obtained at 82.19 with the criteria "Practical".% with the criteria "Practical". Then the average student who shows ease in Square Function material with the help of *GeoGebra* is 70.8 with the criteria "Practical Enough".% with the criteria "Practical Enough".

So it can be concluded that the average percentage of student assessment results of the *GeoGebra* Application on Square Function material at the high school level is 79.67.% with the criteria "Practical". Based on the responses given by students in the student response questionnaire when using *GeoGebra, it is* known that they are still confused about how to learn using *GeoGebra* because they have never used this

application before, but they are motivated and attract students to learn this *GeoGebra-based* Square Function. Students argue that this Square Function is difficult material, because of the prerequisite material that is less mastered and the difficulty of painting function graphs precisely, but with the help of this *GeoGebra* Application can make it easier for us to learn Square Functions. In addition, we also gained new knowledge in learning this math can use an application that can make it easier to solve Square function problems. And also, this learning makes us actively discuss and exchange opinions with groupmates to solve math problems.

GeoGebra is designed to make it easier for students to analyze and solve mathematical problems on Square function material and is practical and easy to understand because there is a picture or visualization of mathematical problems. The learning activities presented by *GeoGebra* can also help students in describing or visualizing the Square function graph.

e) Evaluation Stage

This evaluation stage of the development results that the products produced in *GeoGebra* on class X Square function material fall into the "**Very valid**" and "**practical**" categories. The advantages of using *GeoGebra* make it easier for students to analyze and show the concept of functions and graphs of Square functions. Through learning mathematics with the help of *Geogebra*, students have a responsive, creative, cooperative and enthusiastic attitude in solving the math problems presented. Students can also describe and analyze the characteristics and properties of Square function graphs with the help of the basketball context *GeoGebra* application.

This is in line with a study by [17] found that the use of *GeoGebra* helped students in basic visual depiction in Square functions. Meanwhile, a study by [18] stated an improvement in the ability of students who used *GeoGebra* compared to manual visual depiction. [19] also suggested that *GeoGebra* helped minimize students' conceptual errors in Square function material. In addition, research by [20] mentioned that *GeoGebra* can create independent learning and spark cooperation between students. [21] found that students who are able to use *GeoGebra* have more skills in

working on Square function problems. Finally, a study by [22] mentioned that *GeoGebra* App can have a good influence on students' learning motivation conditions. This supports that learning using only *geogebra* applications can improve the quality of student learning. Plus this study uses a context with a basketball game that is familiar to students.

While the weaknesses in learning using the *GeoGebra* application include students' less strong prerequisite knowledge and some students were confused in operating the Geogebra application on computers and devices because it was new and unfamiliar. However, because it uses the context of a basketball game that is very familiar to students, the enthusiasm of students can help attract students to master the prerequisites and explore computer systems and devices that seem unfamiliar to students.

4. SUGGESTIONS AND CONCLUSIONS

Based on the results of the validation of the *GeoGebra* Application on the presentation feasibility aspect, the combined average percentage of the two validators was classified as "Very Valid". The results of the validation of the *GeoGebra* Application on the feasibility aspect of presentation, instructional design criteria, technical quality, media display and communication indicators using *Likert* scale measurements from the two validators obtained a combined average percentage classified as "Very Valid".

However, after direct testing of 8 X grade high school students, the percentage of student assessment results on the *GeoGebra* Application on Square Function material at the high school level is included in the "Practical" criteria category.

Based on the data above, we can conclude that the *GeoGebra* Application which contains Square Function learning material is not yet fully maximized, there are several aspects that must be improved and improved again to be suitable for use by students, which is intended to make it easier for students to find math problem solving on Square Function material.

It is hoped that further research related to the geogebra application can be further optimized because currently learning must be able to involve and take advantage of

technological developments. In addition, it is hoped that further research can use regional and cultural contexts that must be preserved.

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