The Effects of GeoGebra on Problems Solving Skill in the Integral Calculus

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Abstract. The usefulness of mathematics in the 21st century have been increasingly perceived by the public. Therefore, mathematics is increasingly needed by all people and by society as a whole. In the industrial era now 4.0, there is interaction between human and machine, particularly a computer. One computer application that can be used in problems of mathematics is GeoGebra. GeoGebra is a software dynamic for math, load the feature Geometry and Algebra are mutually connected, and very helpful in understanding and facilitating the teaching and learning of mathematics. The purpose of this study was to determine the effects of GeoGebra on problem solving skills in Integral Calculus. The method of research is quasi-experimental. The research population is the students of study program of mathematics education of one of the private universities in Garut, with a sample of the research is the students of level three. The results of this study concluded that the application of GeoGebra can improve most of the students in the ability to determine area between two curves and determine the volume of objects rotate and create a simulation object play in the Integral Calculus.

Keywords: Integral Calculus, GeoGebra, Problems Solving Skill

1 Introduction

Math is more developed to follow the development of science and technology. And technology is a strength as a source of learning [1]. Therefore, to get the solution of various challenges and responses in education in the era of industry 4.0 today, need to adopt an application-based technology. There are six key elements to encourage 21st century learning: 1) emphasize core subjects, 2) emphasize learning skills, 3) use the tools of the 21st century to develop learning skills, 4) teaching and learning in the context of the 21st century, 5) teach and play the content of the 21st century, and 6) using 21st century that measure 21st-century skills [2]. The use of computers in the classroom is a source of new information which can develop mathematical ideas [3].

GeoGebra is software calculus developed at the University of Cambridge Education Institute, and has received a number of awards such as EASA 2002. In learning Mathematics, GeoGebra is a Mathematical software that has been developed and help in the learning of Mathematics [1]. Geogebra is computer software, and students are certainly interested in the computer, so as to make learning easier [4]. GeoGebra is a software dynamic for math, load the feature Geometry and Algebra are mutually connected, and very helpful in understanding and facilitating the teaching and learning of mathematics [5]. Educators are always doing innovations to success in teaching [6]. To understand a course in calculus, students need to

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develop the ability of symbolic representation and graphics. Geogebra in the learning of Calculus is much more effective than traditional learning in facilitating the learning of the basic concepts of Calculus [7].

The students who are learning, will face the future with the rapid changes in the field of science and technology. Students will need to always learn, become lifelong learners who develop knowledge, technology, be problem solvers, innovators and effective communicators. And can share ideas with others, good at responding positively to change, and become global citizens who have a relationship based on justice and tolerance, as well as the culture of competent, creative and confident in pursuing their passions [8]. Around the world, solving problems has become the objective in student learning [9]. The math teaching has generally issues about paying attention and trusting ownself for learners. To solve such a critical problem, information technology, which are used in educational technologies tool, Geogebra, is used. [10].

1.1 The use of GeoGebra in Problem Solving of the Integral Calculus

Problem solving must be the focus of school mathematics (NCTM, 1980, p.1) [11]. Problem solving becomes the goal in most of the standards and the curriculum documents [12]. statement of the problem leads the students reveal as much as possible about their way of thinking [13]. Mathematics teachers can help students use problem solving heuristics effectively by asking them to focus first on the structural features of a problem rather than its surface-level features (English and Halford, 1995; Gholson et al., 1990). Teachers' emphasis on specific problem solving heuristics (e.g., drawing a diagram, constructing a chart, working backwards) as an integral part of instruction does significantly impact their students' problem solving performance [14]. "Heuristics" describes the literature on mathematical problem solving strategies [11]. The aim of heuristic is to study the methods and rules of discovery and invention [15].

GeoGebra is a free software that brings together geometry, algebra and calculus allowing diverse representations of mathematical objects [7]. Some of the use of GeoGebra in solving the problem of Integral Calculus is as in the following figure:

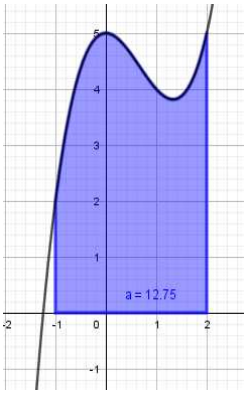

Figure 1. Determine the area

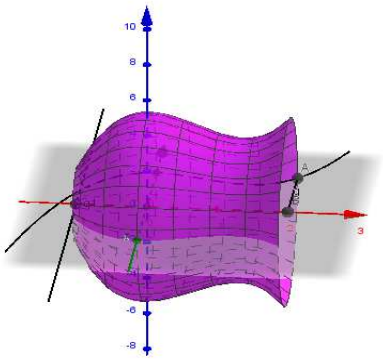

Figure 2. Determine the volume of objects rotate

2. Methods

The purpose of this study was to determine the effects of GeoGebra on problem solving skills in Integral Calculus. The method of research is quasi-experimental. The research population is the students of study program of mathematics education of one of the private universities in Garut, with a sample of the research is the students of level three. The instruments used tests, which are solved by using the app GeoGebra. Criteria assessment using the rubric assessment.

3. Result and Discussion

The results of this study, after being analyzed can be seen as in the following table:

Table 1. Assessment results on determining area between two curves

Determine the Area between two Curves	Percentage
Did Not Answer	0
Determine the Area between two curves but the overall wrong	0
Determine the Area between two curves but there are a lot of mistakes	12
Determine the Area between two curves but there is a slight error	28
Determine the Area between two curves correctly	60

Table 2. The results of the Assessment for Determining the Volume of Objects Rotate and Create a Simulation of rotating Objects

Determine the Volume of rotating Objects and Create a Simulation of rotating Objects	Percentage
Did Not Answer	0
Determine the Volume of rotating Objects and Create a Simulation of rotating Objects but the overall wrong.	0
Determine the Volume of rotating Objects and Create a Simulation of rotating Objects a lot of mistakes.	18
Determine the Volume of rotating Objects and Create a Simulation of rotating Objects but there is a slight error.	30
Determine the Volume of rotating Objects and Create a Simulation of rotating Objects correctly.	52

Based on the data in Table 1, there are students who do a lot of mistakes in determining the size of the area and make a graph of the function, namely the error in determining the value of the abscissa which is the lower limit and the upper limit of the integral equation. While the students do a little error in determining the size of the area and make a graph of the function, lies in the error in determining the sequence of the abscissa which is the lower limit and the upper limit of the integral equation.

Based on the data in Table 2, there are students who do a lot of error in determining the volume of objects rotate and create a simulation object play, that is a mistake in writing the integral equations. While the students do a little error in determining the volume of objects rotate and create a simulation of rotating objects, situated on the error in determining the abscissa which is the lower limit and the upper limit of the integral equation.

4 Conclusion

The use of GeoGebra can improve most of the students in the problem-solving ability in determining the area between two curves, and determine the volume of rotating objects and create simulation objects play in the Integral Calculus.

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