Contextual Teaching and Learning (CTL) Learning Model Using Geometryx Software to Improve Mathematical Creative Thinking Abilities

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Abstract. Creative thinking skills are very important in learning mathematics. A learning model is essential to help students enhance their creative thinking skills, such as the Contextual Teaching and Learning (CTL) model. This study aims to investigate the effectiveness of the Contextual Teaching and Learning (CTL) model using geometryx software to enhance students' creative thinking skills. This study employs a quantitative research method with the CTL learning model, utilizing Geometryx software and a quasi-experimental approach. Experimental research was conducted in the ninth grade of a junior high school with 205 students. The population in this study was more than 100, so a sample of 2 (two) classes was taken, namely the experimental class and the control class, totaling 60 students. Data collection techniques were carried out using a final test, while for data processing using the t-test. The study's findings indicated that the implementation of the CTL learning model in learning mathematics using geometryx software on geometry material could improve the creative thinking skills of students.

Keywords: Creative Thinking Skills, Contextual Teaching and Learning, Geometryx Software.

1 Introduction

Basically, mathematics learning aims to develop creative, critical and logical thinking skills. Training students' thinking skills can start from an understanding of the discipline built on facts, concepts, principles and theories that require creative thinking in everything. Mathematics education is one of the sciences that is very influential in the world of education and must be mastered by students. It necessitates educators' ability to enhance students' creative thinking skills in mathematics learning.

These abilities can be developed through various learning activities because the goals of mathematics education in schools include: (1) practicing drawing conclusions by practicing thinking and reasoning skills; (2) by fostering divergent thinking, originality, curiosity, making predictions, guessing, and experimenting, we can foster creative activities that involve imagination, intuition, and discovery; (3) fostering various types of problem-solving skills; and (4) fostering the ability to convey information and

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communicate ideas. Components that influence student learning outcomes include learning strategies for delivering material or learning models carried out by teachers.

Creativity is the result of the interaction process between individuals and their environment, which means that the environment can support or inhibit a person's creativity, teachers can improve students' mathematical understanding skills and apply creative thinking with learning techniques and discussions on real-world events in everyday life experienced by students using fresh concepts. In education, creativity needs to be emphasized in order to develop the potential of students [12]. This development needs to be trained to students through various learning activities that stimulate creative thinking skills.

Along with the development of the era, in this era of globalization, learning technology has also developed, the role of media has become very essential. Learning media in the form of machinery (technology) is regarded as an application of science, which can include electronic media or other learning technologies playing a crucial role in facilitating and enhancing the learning process. They expand the reach of education (such as through distance learning) and accelerate access (via the internet or computer-based learning), ultimately making a significant contribution to the overall learning experience.

According to Johnston-Wilder [6], developing and getting used to thinking will develop the habit of thinking in context that is useful in everyday life. This is in accordance with Allsopp et al. [3] that learning mathematics meaningfully is a learning activity that helps students become critical thinkers, independent and understand how to apply solutions.

For now, creative thinking is very vital in modern life because the level of complexity of problems is increasing. Based on this, it can be understood that mathematics is a science that is very much needed to enhance students' creative thinking so that it is expected to develop high-quality human resources.

Therefore, one of the skills children need to develop in mathematics is the ability to think creatively. This ability is also recognized that students' creative thinking skills remain low, due to the lack of enthusiasm for learning, motivation, goals, students' understanding of the importance of learning mathematics, students' boredom in learning in class, and the lack of variety in teacher teaching methods.

Contextual Teaching and Learning (CTL) is a learning model that begins with taking, simulating, telling, dialoguing, asking questions, and also learning strategies that connect the information learned with the context of students' daily lives. Contextual learning consists of seven main learning components: constructivism, asking, discovering, learning communities, modeling, reflection, and authentic assessment [4].

Contextual learning is closely related to efforts to enhance students' ability to think critically, especially in the components of asking, finding (inquiry), and reflecting [10]. Through these three components, the ability to analyze, evaluate, and infer questions can be achieved. Adzliana [2] stated that the creative thinking process is a convergent thinking activity to obtain and understand situations, make evaluations and consider the consequences of the solutions taken. Learning about learning mathematics means learning about concepts and structures of the language that must be studied in relation to each other [1]. One of the topics in mathematics that needs to be studied clearly is

geometry. Geometry is the perception of space and the development of visual perception of abstract objects of the mind such as cubes, blocks, prisms, pyramids and so on. Therefore, an update is needed in learning activities regarding geometry during learning, namely by implementing assisted learning media in the form of *Geometryx* software.

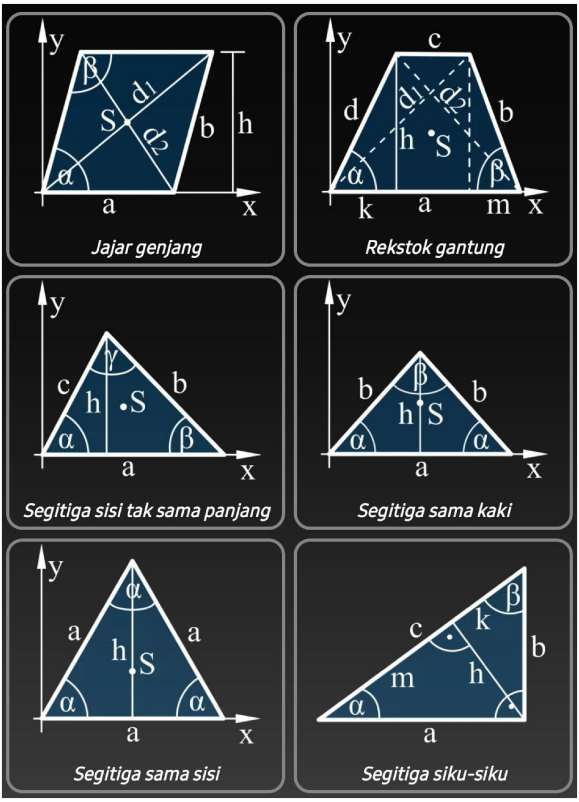

Fig. 1. Geometryx software view

Geometryx is a geometry application (geometry calculator) that can be freely installed on smartphones by downloading it from the Google Play Store. Gaspard Monge around 1799 discovered Descriptive Geometry which is an application of Projective Geometry [9]. Monge developed a study of Descriptive Geometry while teaching at the École Normale, he developed his descriptive method to represent solid objects in three-dimensional (3D) space on a two-dimensional (2D) plane by drawing its projections which were later known as plans, elevations, and traces of solid objects on a piece of paper [9]. From Gaspard Monge's application, it is evident that the key concepts students need to grasp in learning Geometry include abstract concepts (the ability to recognize relationships between the positions of objects in space), frames of reference (markers used to determine the location of objects in space), projective relationships (the skill to view objects from different perspectives), conservation of distance (the

ability to estimate the distance between two points), and mental rotation (the capacity to visualize the rotation of objects in space) [11]. Efforts that should be made to improve students' creative thinking skills should be in accordance with technological developments, one of which is the use of Geometryx Software in learning. Students can openly share their ideas in the learning community and through authentic assessment, increase self-confidence, optimism, and a sense of responsibility.

2 Method

The approach used is a quantitative approach that aims to improve learning practices and the quality of education by taking action to solve problems in learning and improve the learning process. This study employed experimental research to examine the impact of specific treatments on other variables under controlled conditions.

The steps of experimental research in the study are as follows: planning, implementation (action), observation, and reflection. The data collection method is adjusted to the subject matter under consideration, scenarios and conditions, and the accuracy required. Written tests, observations, worksheets, and documentation were used in this study.

Population is all data that is of concern within a predetermined scope and time [9]. The population in this study were all ninth-grade students of a junior high school in Sigli, Aceh, Indonesia, which are 205 students in total. The population in this study was more than 100, so a sample of two classes was taken, namely the experimental class and the control class, the number of which was 60 students. Thus, a class was chosen as the experimental class with geometry material using Geometryx software and a class as the control class. This study is intended to obtain the strength of scientific studies on students' abilities in learning Geometry. The data used in this study is quantitative data. Then, the data were analyzed quantitatively.

3 Result and Discussion

The normality test for the experimental class showed the data is normally distributed. The significance value (p) in the Kolmogorov-Smirnov test is 0.198 ($p > 0.05$), so the data is normally distributed. The significance value (p) in the Shapiro-Wilk test is 0.270 ($p > 0.05$), as seen in Table 1.

Table 1. Normality Test of Experimental Class

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Results	0.100	28	0.198	0.955	28	0.270

For the control class, the significance value (p) in the Kolmogorov-Smirnov test is 0.186 (p> 0.05); as such the data is normally distributed. The significance value (p) in the Shapiro-Wilk test is 0.210 (p> 0.05). Thus, the data distribution is normal, as presented in Table 2.

Table 2. Normality Test of Control Class

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Results	0.096	28	0.186	0.918	28	0.210

In relation to the homogeneity test, we proposed two hypotheses, as follows:

H_0: The results of the experimental class and control class are homogeneous.
H_a: The results of the experimental class and control class are not homogeneous.

The results of the test is showed in Table 3.

Table 3. Tests of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
0.166	1	56	0.680

Based on the output above, the significance value is known to be 0.680> 0.05. This finding indicates that the results of improving Contextual Teaching and Learning through the *Geometryx* application software on geometry material, experimental class and control class (normal) are not homogeneous, which means it is rejected. Based on the normality test that has been carried out previously, it was concluded that the normalized gain score of the class with geometry material using the *Geometryx* application software and the conventional class is normally distributed. So to prove that the normalized gain score of the Contextual Teaching and Learning ability of grade IX students with geometry material with conventional classes, a test of the difference in the average normalized gain score was carried out using the t-test.

Table 4. Normalized Gain Score Mean Difference Test Result Data

t	*df*	*Sig.* (2-tail)	Conclusion
2.700	56	0.000	H_0 Rejected

The table above obtained = 2.700 for with df = 29, value = 1.698, then it is in the rejection area, or a significant value of 0.000 so that it is rejected. This indicates that a notable difference exists between the increase in Contextual Teaching and Learning that gets the Geometryx application software utilization model on geometry material.

Thus, the increase in Contextual Teaching and Learning of students who get the use of Geometryx application software is better than students who get conventional learning. It is aligned with previous research reported that geometry software could improve students' mathematical ability, including cerative thinking [7]. The use of Geometryx has a significant effect on students, as it trains them to think in a systematic and structured manner, fostering critical thinking skills [5]. The Geometryx software also increase students' interest and motivation in learning mathematics [5].

4 Conclusion

The research findings revealed that Geometryx software has a very important role in improving students' creative thinking skills in the Contextual Teaching and Learning approach. Using Geometryx Software helps students better understand abstract math problems. Based on the results of data analysis and discussion of the results of testing the hypothesis carried out on the research data, it showed that there is a difference in improving the Contextual Teaching and Learning of students who are taught using the Geometryx application software with the Contextual Teaching and Learning of students who are taught using conventional methods on the geometry topic. The increase in Contextual Teaching and Learning using the Geometryx application software is because students are more active and can think creatively so that students can solve problems.

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