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Experiment on Ability to Understand Three-Dimensional Material Concepts Related to Learning Styles Using the Geogebra-Supported STAD Learning Model

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Abstra ct

The abstract nature of mathematical objects makes learning mathematics difficult and many students experience difficulties in learning mathematics. The purpose of this study was to determine the effect of the *Geo - Gebra-* assisted STAD learning model on the ability of students' mathematical understanding of learning styles. This study uses a quasi-experimental research method. The population of this study were students of SMA in the 2015/2016 academic year. The research sample was taken by cluster random sampling. The sample size is 64 students, consisting of 34 students in the experimental class and 30 students in the control class. As a research instrument , the researcher conducted a mathematics learning achievement test and a learning style questionnaire. Data were analyzed using two-way ANOVA. The conclusions of this study are: Geogebra- assisted STAD -type collaborative learning model Winplot produces better mathematical comprehension abilities and mathematics learning achievement compared to PowerPoint-assisted direct learning models. Students with a visual learning style are at the same level as students with an auditory learning style. Students with an auditory learning style are at the same level as students with a kinesthetic learning style. Students with a visual learning style perform better in school than students with a kinesthetic learning style .

Keyword: Geogebra, Mathematical Understanding Ability, Power Point, STAD Learning Model

INTRODUCTION

The abstract nature of mathematical objects makes learning mathematics difficult and many students have difficulty learning mathematics (Akhtaruzzaman & Shafie, 2012; Pasaribu, 2013). (Erfjord, 2011) list some of the causes of this problem. Among them is the fact that math lessons seem irrelevant to everyday life (Sesanti, 2015), and the boring way of presenting math lessons from abstract to concrete concepts (Buto, 2010). In this regard, mathematics teachers must understand that mathematical concepts and principles can be fully understood when presented to students in a concrete form (Pavlovičová & Švecová, 2015). In this regard, Bruner argues that the kinesthetic knowledge that students learn can be divided into three levels, namely: active, symbolic, and iconic (Siciliani Barraza, 2014). Paying attention to some of these things is very important to optimize the process of learning mathematics material and maximizing learning outcomes (Takaya, 2008; Walker, 2014).

Geometry is a branch of mathematics that studies points (Arianto et al., 2016), lines (Yuniarti, 2016), planes and spatial objects (Ainiyah, 2016), their properties, dimensions and how they relate to each other (Pambudiarso et al., 2016). The large number of geometric shapes

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found in real life is the reason why every mathematics student must learn this material (Rohimah & Nursuprianah, 2016). Geometry has a lot to do with everyday life, but it is not always easy for students to learn. Including when students study three-dimensional material.

Based on several surveys that have been conducted, it turns out that there are still many students who have difficulty mastering this material. Students experience difficulties in understanding the concept so that in solving the problems given it shows errors that tend to be abstract. Abstraction errors in question, namely the distance on the plane, the angle between the line and the plane, and procedural errors, namely the calculation of the shape of the root. It turned out to be an actual abstraction error. Using the Pythagorean formula results in conceptual errors in the concepts of distances and angles.

Another study found that student questions contained information such as: Difficulties in interpreting information in questions (Khotimah et al., 2016), language difficulties, difficulties in understanding geometric concepts and principles (Duskri et al., 2014), and technical difficulties. Difficulty in solving geometry problems related to weaknesses in understanding geometric concepts and principles (Hadi et al., 2015). Geometry concepts that are not mastered by students are diagonal, distance, height, quadrilateral, and area. The geometric principles that students have not mastered are: the principle of measuring height (Hardiyanti et al., 2016); the principle of measuring the distance between points and line segments (lines); Measures the distance between two parallel segments (lines). The principle of measuring the diagonal of a square. The principle of calculating the area of a rectangle. Difficulty learning geometry occurs even in high school. As stated (Soares, 2013), students experience difficulties in understanding geometric concepts, applying concepts, understanding formulas, and determining painting techniques. Geometry is one of the mathematical materials that is focused on acquiring special understanding and process competence, therefore teaching this material requires appropriate learning models and learning media. With the right learning model and the right learning media, the quality of learning in this subject is very likely to increase .

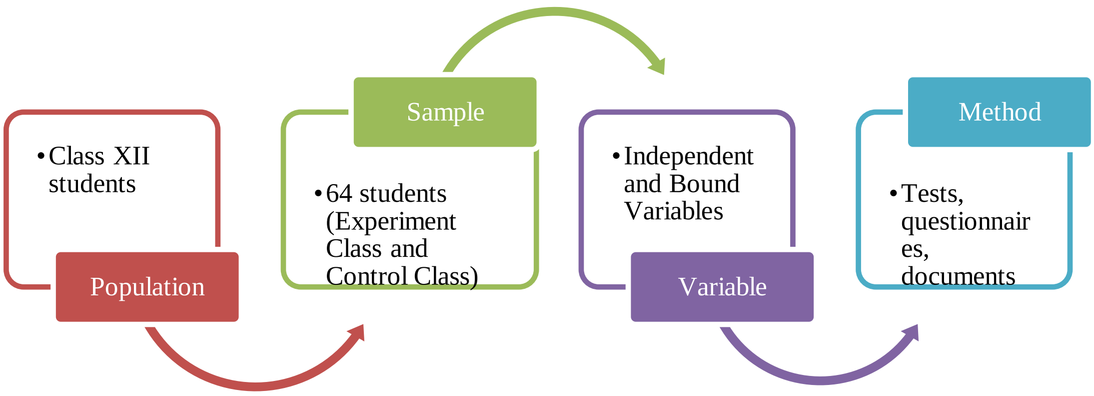
In this context, the application of a collaborative learning model becomes food for thought to improve the quality of learning. The main feature of the collaborative learning model is working with other friends to learn material (such as geometry material) that students can use to improve their thinking skills when learning mathematics. The results of several studies also show that the collaborative learning model has a positive impact on student performance. and trance. A study by (Esminarto et al., 2016)this collaborative learning model implemented in Malaysia has improved students' learning outcomes and attitudes towards mathematics. On the other hand, research conducted by (Adrian et al., 2016)also found that cooperative learning can effectively increase the level of academic achievement of participating students and foster a positive attitude towards mathematics in students. Based on the ideas and research results, the application of collaborative models can increase and improve the quality and improvement of student learning outcomes in geometry teaching materials.

The collaborative learning model is a learning model that is applied to create concepts in debriefing and discussion and working together in groups to solve problems. This learning model has several variations related to the collaboration model. Slavin explained the types of learning models include (Blum & Borromeo, 2009; Rusman, 2016; Yan et al., 2008): Team Game Tournaments (TGT), Jigsaw, Cooperative Integrated Reading and Composition (CIRC), Student Teams Achievement Divisions (STAD), Team Assisted Individualization (TAI), Academic Controversy (AC), and Group Investigation (GI). In addition to using the right learning model, thinking skills can be optimized by using the right learning media to support the use of the learning model. According to (Soeiro et al., 2012), one of the benefits of learning media is to improve the learning process and learning outcomes. Many students find it difficult to abstract geometric concepts, so that educational media makes it easier for students to understand existing concepts. The available media for geometry teaching materials include Maple software, GeoGebra software (Hendratmoko, 2015), and PowerPoint software (Murtikusuma, 2015). Related to these various media, researchers are interested in studying geometry using the GeoGebra software media. This computer application-based media is considered a suitable tool for learning geometry teaching materials. The use of media is also seen as important to cover some of the weaknesses of the collaborative learning model so that the results can truly optimize student learning. In addition, several studies have shown that computer-based media has a positive effect on mathematics learning achievement, as was done by (Alfi et al., 2016; Oktaria et al., 2016; Pawson et al., 2006).

Students' understanding of geometry material can also be influenced by their learning style. Learning style is one of the internal factors that is believed to have a strong influence on students' mathematics achievement. Learning style is how a person processes and processes information in learning situations. Based on this, it is very possible that the bias in each student's learning style will affect their learning success. Based on some of the questions above, the authors explore experimental interests in their research. The PowerPoint direct learning model is a model that is commonly used by face-to-face teachers. In other words, the class that is the subject of hands-on learning with PowerPoint is the control class in this study .

RESEARCH METHOD

The survey was conducted for five months from January 2016 to May 2016. The research approach is quantitative and the research method used is quasi-experimental. Note the research flow with the 2 x 3 factorial design used as the research design in Figure 1 below.



Gambar 1. Alur Komponen Penelitian Eksperimen STAD

In Figure 1 above, it can be explained that the population of this study were all students of class XIIA and XIIB SMA Wachid Hasyim 2015/2016 academic year. The research sample was taken by cluster random sampling. The sample size is 64 students, consisting of 34 students in the experimental class and 30 students in the control class. The independent variables in this study are learning models and learning styles, and the dependent variable is the results of learning mathematics in understanding mathematical concepts. Data collection methods are tests, questionnaires and documents. The test method was used to obtain data on mathematics learning outcomes, the questionnaire method was used to collect data on student learning styles, and the documentation method was used to collect data from survey samples and the document standardization method was used to collect data on initial abilities. Initial achievement data was obtained from student scores in the geometry subject, namely the third dimension in the even semester midterm exams (UTS). The data is used as the basis for the balance test in this study. Tests and questionnaires served as tools for this study. Mathematics Learning Achievement

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Test and Learning Style Questionnaire. The two previous test instruments were tested for content validity and reliability.

Before conducting the research, the researcher first conducted a balance test between the two population groups. The statistical test used is the t test. This test is carried out after the conditions for normality and uniformity of the population variance are met. Furthermore, according to the previously formulated research design, two-way ANOVA with different cells was used in this study to test the hypothesis. This test is carried out after the conditions for normality and uniformity of the population variance are met. The Lilliefors method was used to test for normality and the Bartlett test was used to test the homogeneity of population variances.

RESULTS AND DISCUSSION

In this study four hypotheses were proposed. Tests of four hypotheses were also carried out, leading to the above results. Based on the results of hypothesis testing, then the four hypotheses that have been formulated are discussed. A simple ANOVA calculation with different cells gives a critical range, or DK={F|F>5.17}, where F_(a) equals 73.42. These results provide a test decision that H_0A is rejected and allow us to conclude the differences in the impact of different learning models on mathematics learning performance. In other words, not all models have the same impact on mathematics learning achievement. H_0A is rejected, but multiple comparison tests are not performed because there are only two values for this variable. By looking at the average cut-off, it can be concluded that the Geogebra-assisted STAD learning model outperforms the PowerPoint-assisted direct learning model for class XII students at SMA Negeri 1 Kalianda.

The STAD learning model using Geogebra improves the learning outcomes of class XII students at SMA Negeri 1 Kalianda compared to the direct learning model using PowerPoint. This result is consistent with the previously formulated hypothesis. These results are also consistent with research (Rochmad & Masrukan, 2016; Syamsiyah & Wedyawati, 2016). Tran showed that the collaborative learning model improves the performance of learning mathematics and outperforms the traditional learning model. These results also complement previous research on computer media, such as that conducted by (Hamidah & Sihombing, 2016; Ulya & Kartono, 2012). Results (William, 2006). shows that computer-assisted media has a positive effect on mathematics learning achievement. A number of computers (laptops) were used in the group in this study, but this did not change the nature of the STAD model implementation as modified in this study. This is because the STAD model prioritizes group work rather than individual work. So having a laptop in each group really creates a dynamic of interaction and learning that helps students develop a better understanding of similar material.

Furthermore, a two-way ANOVA calculation using different cells from the second hypothesis yields F_(b) 26.73 with a critical range or DK={F|F>4.12}. This result gives the decision of the test being rejected by H_0B, and it can be concluded that there are differences in the effect of learning styles on mathematics learning achievement. Since H_0Bit was rejected, further post-Anava tests were performed using Sceffe's method. Further testing shows that students with a visual learning style show the same learning outcomes as students with an auditory learning style, students with an auditory learning style show the same learning outcomes as students with a kinesthetic learning style, and students with a visual learning style show the same learning outcomes . better than students with kinesthetic learning styles. These results are generalizable as part of the conclusions of this study. There are results that contradict the second hypothesis formulated in this study that students with an auditory learning style learn better than students with a kinesthetic learning style. There may be external variables beyond the control of the researcher. Classrooms that tend to be overcrowded can hinder learning by preventing students with an

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auditory learning style from reaching their full potential in discussion.

In the third hypothesis, one-way ANOVA calculations with different cells yield F_(obs) for H 0AB of 23.02 to the critical range, or DK = {F|F>4.21}. These results provide a test decision to discard H_0ABis and allow us to infer the interaction between learning models and learning styles in mathematics learning performance. H_0ABit is rejected, so further tests should be performed after the ANOVA. Both are tests of multiple comparisons between cells in the same column. From the third hypothesis multiple comparison test we conclude that: 1) For students with a visual learning style, his GeoGebra-enabled STAD model provides better learning outcomes than the PowerPoint-enabled direct learning model. 2) For students with an auditory learning style, the GeoGebra-enabled STAD model produces the same learning achievement. 3) As a PowerPoint-assisted direct learning model, the STAD model with GeoGebra produces the same learning outcomes as the PowerPoint-assisted direct learning model when students use kinesthetic learning styles. These results are generalized according to the third problem formulation proposed in this study.

There is one hypothesis about these results that is not supported by the research data. In other words, the hypothesis proposed is that the GeoGebra-assisted STAD model is superior to the PowerPoint-assisted direct learning model for auditory learning style students. Researchers have analyzed all the reasons why this hypothesis cannot be accepted. Based on this analysis, the researcher believes that the rejection of this hypothesis may be caused by the influence of external variables that are beyond the control of the researcher, especially the many intervening variables that are very likely to influence the results of this study.

For the fourth hypothesis, a one-way ANOVA calculation using different cells gives F_(obs) for H 0AB equal to 23.02 up to the critical range, or DK={F|F>4.21}. These results provide a test decision that H_0ABis is discarded, so that it can be concluded that the interaction between learning models and learning styles on mathematics learning achievement. Because H_0ABit is rejected, it is necessary to carry out a post-ANOVA follow-up test, both the multiple comparison test between cells in the same column. From the results of multiple comparison tests for this hypothesis, it can be concluded that: 1) in the Geogebra-assisted STAD learning model, students with a visual learning style have the same learning achievement as students with an auditory learning style, students with an auditory learning style have the same learning achievement as students with a kinesthetic learning style, and students with a visual learning style have better learning achievements than students with a kinesthetic learning style and 2) in the PowerPoint-assisted direct learning model, students with a visual learning style have the same learning achievements as students with an auditory learning style , students with auditory learning style have higher learning achievement. the same as kinesthetic learning style students, and visual learning style students have the same learning achievement as kinesthetic learning style students. These results are generalized as a conclusion from the fourth hypothesis of this study. Of the six hypotheses which are part of the fourth hypothesis, there is one hypothesis that is not in accordance with the research data. That is, in the STAD learning model supported by Geogebra, the hypothesis is that students with an auditory learning style perform better than students with an auditory learning style. Although the results of the probability analysis underlying this hypothesis are inconsistent with the research data due to the influence of external variables beyond the control of the researcher, there is a possibility that these variables do influence the research data. Crowded class conditions can be a dominant factor for students with an auditory learning style who cannot speak optimally by applying the STAD model to improve student performance. There are properties. This is believed to affect learning outcomes that are less than optimal

CONCLUSION

Based on the results of the analysis and discussion of hypothesis testing, as well as referring

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to the formulation of the problem in this study, the following conclusions can be drawn. *First,* the Geogebra-assisted STAD learning model provides better learning outcomes compared to the PowerPoint-assisted direct learning model for class XII students at SMA Negeri 1 Kalianda. *Second,* students with a visual learning style have the same learning outcomes as students with an auditory learning style, students with an auditory learning style have the same learning outcomes as students with a kinesthetic learning style, and students with a visual learning style have better learning outcomes. I have. It outperforms its students with a kinesthetic learning style. *Third,* the GeoGebra-assisted STAD model achieves better learning outcomes than the PowerPoint-assisted direct learning model. For students with an auditory learning style, the STAD model with GeoGebra offers the same learning performance as the hands-on learning model with PowerPoint. For students with a kinesthetic learning style, the STAD model powered by GeoGebra offers the same learning performance as the live learning model powered by PowerPoint.

Next, *fourth.* In the Geogebra-assisted STAD learning model, students with a visual learning style achieve the same learning outcomes as students with an auditory learning style, students with an auditory learning style achieve the same learning outcomes as students with a kinesthetic learning style, and students with a visual learning style achieve learning outcomes the same one. the same learning outcomes. Learning outcomes are the same as students with a visual learning style. Learning styles produce better learning outcomes than students with kinesthetic learning styles. In the direct learning model that supports PowerPoint, students with a visual learning style have the same learning outcomes as students with an auditory learning style, students with an auditory learning style have the same learning outcomes as students with a kinesthetic learning style, and students with a visual learning style have the same learning outcomes. learning the same as students with visual learning styles. learning outcomes are the same as students with an auditory learning style. Students will have the same learning outcomes as students with visual learning styles. kinesthetic learning. Looking at the results of this study in general, the authors' suggestions below may be useful for teachers and other researchers who wish to conduct similar research.

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