THE EFFECT OF DISCOVERY LEARNING ON STUDENTS' MATHEMATICAL DISCOVERY SKILL

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ABSTRACT

Mathematical discoveries are useful in supporting science and technology development. Nevertheless, there was not as much attention about discovery of mathematics in the school environment. Therefore, students need learning environment so they could learn to study who to discover mathematics. The research aims to analyze the impact of the combining of technology in discovery learning on students' skill in discovering mathematics. In addition, the research examines the influences of other factors, namely school qualification and prior knowledge. The research was a quasi-experimental with posttest-only design. Based on analysis of data, it was able to be concluded that the learning factor did not effect on students' skill in discovering mathematics and there were effects of qualifications of school and prior knowledge. There was a significant interaction between approaches of learning and school qualifications on the students' skill in discovering mathematics. The interaction between approach of learning and prior knowledge; between the school qualification and prior knowledge; and among approach of learning, qualifications of school, and prior knowledge on the students' skill in discovering mathematics was no significant. Integrating technology in discovery learning be able to be applied in teaching and learning of mathematics especially in high level of qualification of school and high level of prior knowledge of students to improve their skill in discovering mathematics.

Keywords: technology, discovery learning, mathematical discovery

INTRODUCTION

The development of people and societies need mathematics as tools to solve problems (Fatima, 2015). In a social environment, one needs the skill to cooperate and communicate with others. Cooperation and communication process can occur in a transaction and other activities that could not be separated from mathematics. Moreover, mathematics is also required individual in his intellectual development. Problem-solving activities in mathematics assist students in developing skill of thinking. These activities will form the constructive and creative mindsets. This is a process which will affect the mental abilities of students in everyday life.

The role of mathematics in society can be seen in various fields, for example in education, economic development, and science and technology development. In education system, we can see that almost every subject need or learn mathematics. In development economics, mathematics is a proponent of economics. Mathematics has been applied in business and financial services. In science and technology development, the mathematical result in the existence of science and technology. Mathematics widely adopted in various sciences, from social sciences to medicine and medical. Mathematics has also been successfully used in the science and technology development in this century.

It can be seen in the application of mathematics in a variety of fields, from biotechnology to planetary exploration. As the basic in supporting science and technology, mathematics needs to be developed so as to produce much mathematical knowledge needed for mankind. Such knowledge is also expected to be applied in everyday life in a variety of tools and technologies. Therefore, the world is waiting for more discoveries in mathematics as an effort to improve the life of mankind. Mathematicians are needed in discovering new mathematical discovery. One way of creating mathematicians is to train and educate prospective mathematicians in school. Therefore, teachers need to improve their role in producing new prospective inventors in mathematics. However, at present the most math teachers only produce students or graduates who have little mathematical skills and did not have the insight or experience in mathematical discovery (Xavier, 2013).

Teaching and Learning in schools today is felt mostly has unleashed the mathematical aspects of its characteristics. Teachers explained mathematics teaching material without presenting mathematical algorithm. Students did not learn why mathematics requires a conjecture and concepts; they rarely find why definitions, examples, theorems, and proving extremely important or interesting; and students think that learning mathematics is only to learn about the rigid rules and the steps (Wilson, 2003). Each student would not have to be a mathematician or to be good at math. But students need to master mathematics early on to face the technological developments and the progress of time. Therefore, equip students with the mathematical discovery capskill is needed, so that learners can have the skill to find patterns that occur in real life are always changing, uncertain and competitive.

By finding patterns that occur in everyday life, students are expected to predict and solve a problem that will be and are being addressed. Mathematical discovery in learning activities in the classroom is only possible in an appropriate learning environment. The use of multi-strategy approach and the use of technology which is a requirement of the national curriculum allows it to be used as a tool in mathematical discovery. However, it is general news that the learning strategies used by teachers not changed much from the beginning until now. Math teachers still use conventional learning in delivering the subject matter. Most mathematics teachers rarely use technology in mathematics teaching so that the progressing of integration of technology in the mathematics learning was very slowly. In addition, some teachers have access to use a computer and compatible software both at school and at home, however, the technology and the existing facilities are rarely integrated by teachers in teaching on a regular activity (Zilinskiene&Demirbilek, 2014). A teacher must have the skill, skill, and creativity in planning and creating appropriate learning activities for students to produce a mathematical discovery.

Creativity exists in various fields of human activity and all the people both young and old have the creative skill. Creative skill could be used to generate the discovery. The discovery can be generated by observing the patterns. Observations can be done on a shared field of study, especially in mathematics. This is probably due to the mathematical reality that actually exist outside of us and our job is to discover or observe (Hardy, 1940). Characteristic of learning activities that allow it generates a discovery is a learning activity that allows students to do observations. Obviously these observations by a task or activity and problems that allow the students to acquire a variety of results, make mistakes, make improvements, and summarize the results that have been obtained. One of alternative learning approach that has these characteristics is discovery learning. Discovery learning possible due to discover of several mathematical discovery that a settlement of an issue or activity. In addition, the teachers involved in the activities of the experiment or observation and mathematical discoveries. An interesting experience of successful in using of discovery learning is expected to encourage the willingness of teachers to use discovery learning in teaching activities. In addition to discovery learning, technology (computers) can also be used as a tool in mathematical discovery activities (Colton, 2007).

Technology has influenced education in today's world. That is because the availskill of various hardware and software and information and communications technology (ICT) that can be used by students to learn. ICT least affects subjects in school, knowledge, curriculum, experts, the way of teachers in teaching, how students in working either individually or in a group, and the way students in learning. The effect has consequences for the teacher competence and has implications for education. Teachers need to use these technologies in both the classroom and laboratory (Cornu, 1999).

Technology is not a tool that can solve all the problems in education. However, technology can be integrated in the process of learning to enhance the students' learning experience and it can help students in improving the understanding of important concepts and issues relating to subjects (Alias, 2009). One of technology that can be used teachers in learning activities in the classroom is a dynamic mathematics software GeoGebra. GeoGebra can be used in learning-oriented activity and problems (Majerek, 2014). According to Evans (May 2013), the developer of GeoGebra expect that with this software will be easy to understand mathematics. He wanted to show to students that math is useful and interesting. Students be able to play mathematics with GeoGebra s. They can do things quickly, shifts a point, be able to experiment with mathematics, and how these are expected to be making a better understanding of the student. Therefore, introducing GeoGebra is a great way to enhance the learning quality and is expected to improve student learning outcomes that better (Kyeong, 2010; Ljajko, 2013). Students be able to see abstract concepts, make connections, and discover mathematics with GeoGebra (Antohe, 2009). Additionally, Anabousy, Daher, Baya'a, and Abu-Naja (2014) states that students are generally successful transformation functions in algebra and graph representation when using GeoGebra.

Discovery learning provide a more effective influence in mathematics compared to conventional learning in improving the understanding and use of mathematical concepts students in real life. Additionally, Leinwand and Burrill (2001) added that technology is important in the learning of mathematics. However, integrating GeoGebra in learning activities with the discovery learning approach is not an easy matter. A little bit of training material on discovery learning and the availskill of computer labs are not enough to guarantee the implementation of the use of computers in teaching on a regular activity (Zazkis, 2010). Some of the things that causing a person difficulty in integrating technology into discovery learning is the lack of skill to connect between ideas, knowledge, action, and the lack of teaching resources that integrate technology with discovery learning.

In general, a person who be able to effectively integrate technology in learning usually have a good skill to master technology. However, someone who has a good skill in mastering the technology does not necessarily have the skill to use these abilities in teaching. Therefore, once a teacher needs to master the technology and how to use them in learning for the purpose of learning activities can be achieved. One effort to encourage mathematical software can be used on a regular teaching in the classroom is to train teachers using these devices (Gawlick, 2002). Kennedy, Tipps, and Johnson (2008) added that the accuracy of the use of computers and programs that are effective in learning the things that will benefit students when learning to use computers in teaching and learning are applied. However, the use of computers will not help much if the software used is not combined with appropriate learning techniques. As examples were teaching methods to student-centered, active learning methods, learning through discovery, through practice, and through experimentation. Designed research is expected to provide new learning experiences in developing of students' skill in discovering mathematics.

Mathematical discovery in this study can be done with a variety of learning activities. Activities can include activities to generate concepts, conjectures, theorems, and proofs. Identify gaps a theorem, simplifying a proof, generates a new proof method, and found the technique to construct a concept can also be seen as a mathematical discovery activities (Colton, 2007). Creative learning activities to bring mathematical discovery is very concerned with the situation or mathematical problems that can bring creativity in the classroom. Situation or a mathematical problem that is at least a familiar situation and problems with everyday life. In addition, situations and issues presented can be manipulated so that students can explore, providing resources for student questions, and provide materials and equipment that will encourage students conduct experiments. Another thing to be done is giving time to the students in manipulating discussion, experimenting, encouraging students not to be afraid to make mistakes that can later be repaired, and a conclusion or success of such activities. Provision of guidance, reflection, and strengthening of the ideas and hypotheses of students is also important in addition to giving positive feedback on students' work. Researcher or teacher should know at the time when or under what circumstances a student should be given guidance or assistance.

Reflection is needed in the students' understanding of the material provided and strengthening is a means to broaden or deepen mastery and knowledge of students in a particular study. Therefore, this study is one of the efforts in providing new learning experiences for students to creatively so as to produce a mathematical discovery. This is done by combining the discovery learning with GeoGebra that aims to improve the skill of mathematical discovery. The skill of discovering mathematics demands students' thinking skills. However, of course, something that is common if the level of thinking skills among students who are different from one another.

Differences can occur among students in the classroom and the school. Therefore, it is not impossible that the students' thinking skills will be different if they come from different schools and even at different school levels. This is reinforced by customs that, in general, schools that qualified will only accept students with high skill and vice versa schools that qualified low will accept students who have the skill to lower when compared with students who enter the school are highly qualified. Additionally, the facilities owned by the school can be used as an indicator of school qualifications. Well-qualified schools usually have a more complete facilities of schools qualified underneath. Good facilities deemed or donate the smooth learning in the classroom. Students may also be motivated to study diligently in order to optimize all its potential. The potential skill of students to each other certainly different. This is due to the experience that has been passed by the student and the nature of mathematical structure. Students will not be easy to master math concepts if he does not master the basic concepts of others. Mastery of concepts or cognitive early is very important in understanding or mastering new math concepts. Therefore, factors other than learning, factors qualifying school and prior knowledge of mathematical also a factor that is important to be studied in this research because it is probable that in a study of the effect of a factor can also be influenced by other factors because of interactions that occur between two or more factors involved in a study is a blend not aware that occur in the study.

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METHODOLOGY

The method used is a quasi-experimental research (Prancan & Wise, 2002) as shown below.

$$\begin{array}{ccc} NR & X & O_1 \\ \hdashline NR & & O_2 \end{array}$$

Note:

NR = Nonrandom
X = Discovery Learning + GeoGebra Software (DL+GS)
$O_1 = O_2$ = Test of Skill of Mathematical Discovery

Experimental class was taught by discovery learning aided GeoGebra (X) and control class was taught conventionally. At the end of the learning activity, students who were in both of sample class were given a final test ($O_1 = O_2$), which is a test to assess the skill of their mathematical discoveries.

Subjects of this study were grade 7 of junior high school students in Ternate City, North Maluku, Indonesia. Total of junior high schools in Ternate City is 18. There are nine public schools and nine private schools and 11 schools leveled A and 7 school leveled B. From each group were selected 2 school of A level and 2 schools of B level. This process based research consideration of curriculum implemented in each school and the computer facilities in the school. Total of students are 142 with 61 students in the experimental class and 81 in the control class.

Test of prior knowledge was conducted before learning process to both of experimental and control class. Based on data analysis, there was no difference of students' skill of prior knowledge between experiment and control class. There are two research instrumen in this research, namely tes of prior knowledge and tes of skill in discovering mathematics. Test of prior knowledge is used to measure students' understanding of students' knowledge that have been studied and estimated supporting topic about triangle and quadrilateral. These topics include Numbers, Algebra, and Angles, and Cartesian Coordinates. Test of skill of mathematical discovery be used to determine the skill of students' mathematical discovery in constructing concept, conjecture, a theorem, proof, simplification of proof, and the discovering of new methods. Data of research about students' skill in discovering mathematics were analyzed by SPSS *(Statistical Product and Service Solution),* preceded by a test of normality and homogeneity of variance. Both of tests were used as a consideration of type of statistics tes, parametric or nonparametric tests.

RESULTS

The average value of students' skill in discovering mathematics from the experimental class was 7.10 with 4, 979 standar deviation. On the other hand, the average value of students' skill in discovering mathematics in control class was 6.36 with a standard deviation of 4.154. The data showed that Students' skill of mathematical discovery in experiment class was higher than that of control class. However, the range of data of students in experiment class looks more spread out than the range of data of students in a control class. It could be show from the standard deviation of experiment class higher than that of control class. Score of students' skill of mathematical discovery is between 0 and 23. Score of students' skill of mathematical discovery of experiment class be able to be categorized in the low category and score of Students' skill of mathematical discovery of control class can be categorized in very low criteria.

School qualification or level of school accreditation obtained based on the activities of a systematic and comprehensive assessment through self-evaluation and external evaluation. This level can be used as a description of the feasibility and performance of schools. Students from different school qualifications can be expected to have a different learning achievement. It is certainly reasonable because well-qualified schools have also a good learning environment so that students will be encouraged to improve learning outcomes. The average score of Students' skill of mathematical discovery from schools that qualified A amounted to 8.61 with a standard deviation of 4.590 of 83 students. On the other hand, the average score of Students' skill of mathematical discovery from schools that qualified B of 3.95 with a standard deviation of 59 students is 2,655. Mean score of students' skill of mathematical discoveries from schools with level A higher than mean score of students' skill of mathematical discoveries from schools with level B. Data Distribution of Students' skill of mathematical discovery from school level A also more spread.

Prior knowledge describes students' understanding of subject learned. Teachers can use description students' prior knowledge for designing learning activities and giving deeper understanding of students if it needed. This study classified students into three groups of prior knowledge, namely high, medium, and low. The mean score of Students' skill of mathematical discovery from high level prior knowledge is 8.77 with a standard deviation of 4.183 of 39 students. The mean score of Students' skill of mathematical discovery from medium level is 5.81 with a standard deviation of 4.121 of 64 students. In addition, the mean score of Students' skill of mathematical discovery from low level is 6.00 with a standard deviation of 4.910 of 39 students. The data show that the skill of mathematical discovery of a group of students with high level prior knowledge was the highest. Nevertheless, the skill of students' mathematical discovery in the medium level was lower than the skill of a group of students in low level. On average skill students 'mathematical discovery of high group can be categorized in the criteria for low and average students' mathematical discovery capabilities medium and low level were included in the criteria is very low. The mean of score of the three levels of student' skill of mathematical was 6.68. Therefore, the skill of students' mathematical discovery of all the students involved in this study can be categorized in the low criteria.

Based on tests of normality and homogeneity of variance of data Students' skill of mathematical discovery for learning factors, the statistical test used in this analysis is a nonparametric test. Nonparametric tests used were Mann-Whitney test. Mann-Whitney test is an alternative to the t-test of two independent samples. Data analysis showed that the *p-value* for two-tailed test was greater than 0.05. It could be concluded that there was no significant difference between students' skill of mathematical discovery between experiment and control groups.

Normality test concluded that the data of Students' skill of mathematical discovery from schools level A derived from normal distribution while data of Students' skill of mathematical discovery from schools level B and were not derived from populations that were normally distributed. Moreover, the conclusion of analysis data showed that the two groups have different variances. Therefore, statistical tests were used to determine the effect of school level on Students' skill of mathematical discovery was a nonparametric test. Based on nonparametric test it could be seen that *p-value* < 0.05. Therefore, it could be concluded that the skill of students' mathematical discoveries influenced by school qualifications.

Normality test of data of Students' skill of mathematical discovery based on level of students' prior knowledge concluded that the data of Students' skill of mathematical discovery from high level is normally distributed and data of Students' skill of mathematical discovery from low and medium levels are not normally distributed. Moreover, it also concluded that the variance three of that level were homogen. Based on both of these tests then selected nonparametric tests to determine the effect of prior knowledge on the skill of students' mathematical discovery. Therefore the number of groups being compared more than two, then a nonparametric test was used Kruskal-Wallis test. Kruskal-Wallis test results showed *a p-value* < 0.05. It showed that there was significant effect of prior knowledge to Students' skill of mathematical discovery.

The analysis used to determine whether there was interaction of each factor on the students' skill mathematical discovery was the adjusted transform rank test (Leys & Schumann, 2010). The test is a nonparametric test to determine the interaction of the factors involved in this study. Factor A was approach of learning and factor B is the school qualification. The interaction between the factors of learning approaches and school qualification had *p-value* < 0.05. F value = 6.286. When the value F is confirmed by Table F ($F_{T)}$ with α = 0.01 or 1% significance level, where df are 1 and 138 respectively for the numerator and denominator, showed F_T = 6.822, which is greater than the F. Therefore, the alternative hypothesis ($H_{a)}$ maintained for a significant level of 5%, but declined to 1% significance level. Based on this it can be concluded that there is an interaction between learning approaches and schools qualification for a significant level of 5%.

The assumptions of normality and homogeneity were not fulfilled in the data of mathematical discovery in terms of mathematical approach and prior knowledge was not possible to test the interaction of these two factors with parametric test. Therefore, the statistical test used to determine whether there is an interaction between learning approaches and prior knowledge was nonparametric tests. There are two factors, factors A and C. Factor A was a factor approach to learning and factor C was prior knowledge. Both of factors had a *p-value* > 0.05. F value = 1.611. When the value of F is confirmed by Table F with α = 0.10 or 10% significance level, where df were 2 and 136 respectively for the numerator and denominator, show F_T = 2,342, which is greater than the F. If studied further, then the value F will be greater than F_T if we raise the value of the significant level. Based on the value F_{T}-seeking activities that are smaller than F with the help of excel, then derived indigo F_T = 1,579. This value is the value of α = 0.21 with df are 2 and 136 respectively as the numerator and the denominator. Therefore, the alternative hypothesis ($H_{a)}$ refused to significant level of 5%, but could not be rejected for a significant level of 21%. Based on this it can be concluded that there was an interaction between learning approach and prior knowledge of the mathematical skill of students' mathematical discovery at significant level of 21%.

The interaction between the three factors, namely learning approaches, school qualifications, and prior knowledge on the students' skill of mathematical discoveries were analyzed by nonparametric tests, transform the adjusted rank test. Factor A, B, and C are respectively the learning approaches, school qualifications, and prior knowledge. prior knowledge. The interaction between the factors of learning approaches, school qualifications, and prior knowledge have *p-value*> 0.05. Value of F = 0.014. When the value of F is confirmed by Table F ($F_{T)}$ with α = 0.10 or 10% significance level, where df are 2 and 130 respectively for the numerator and denominator, the F_T = 2,344, which is greater than the F. If studied further, then the value F will be greater than F_T if we raise the value of the significant level. Based on the value F_T seeking activities that are smaller than F with the help of excel, then derived F_T = 0.010. This value is the value of α = 0.99 with df were 2 and 130 respectively as the numerator and the denominator. Therefore, the alternative hypothesis ($H_{a)}$ rejected to significant level of 5%, but could not rejeced for a significant level of 99%. Based on this it can be concluded that there is interaction between learning approaches, school qualifications, and mathematical skill early on the skill of students' mathematical discovery at significant level of 99%.

Students' skill of mathematical discovery in this study reflected their mathematical understanding and it consists of four indicators. All indicators were used to assess students' skill of mathematical discovery. First indicator assess students how they generating, exploring and interpreting the relationship properties in the angles and lines of triangle. Second indicator describe students' skill how they generating, exploring, and interpreting the relationship of properties of midpoints of the sides of the quadrangle and conclude form of shape formed by the midpoints. Third indicator evaluated students' skill in generating, exploring and interpreting the relationship between the properties of diagonal lines and the area which is divided by a diagonal in the parallelogram. Fourth indicator assess students' skill in generating, exploring, and interpreting the properties of the line formed by the relationship between the diagonal lines, median, and parallel line to the side of the trapezoid.

The first indicator is used to assess students' skill to construct a conjecture in a triangle. Students had to construct an isosceles triangle *ABC* which A as vertex point. After that, draw bisector lines on $\angle ACB$ and $\angle ABC$ so that the cut side *AB* and side *AC* at point *D* and E. Next step, draw bisector line for $\angle ABE$ and $\angle ACD$ so both of bisector lines intersect on point F. They had to conclude what is relation among the $\angle BDC$, $\angle BFC$ and $\angle BEC$. Maximum score of this task is 6.

The second item is used to assess students' skill to generate, explore, and interpret relations between midpoints of the sides of the quadrangle and shape formed by the midpoints. Students' skill of mathematical discovery are assessed based on how students work in drawing a quadrangle ABCD; drawing the midpoint on each side of the quadrangle and renamed it the point P, Q, *R, and* S; connecting the midpoints; and concludes name quadrangle *PQRS.* Each step was given a score of 1, so that the maximum score of students' skill of mathematical discovery this task is 4.

Third indicator evaluated students' skill in generating, exploring and interpreting the relationship between the properties of diagonal lines and the area which is divided by a diagonal in the parallelogram. This task consists of several points of questions that will drive the main answer to the last point. In this task, a picture presented which is expected to facilitate students in completing the questions. Supporting information was expected to contribute to the student in understanding of the image. This task emphasizes understanding and ingenuity of students in the area of the triangle observed pattern of relationships in a parallelogram. Students' skill of mathematical discovery was assessed based on the students' answers to each of the points in question, namely in demonstrating the students' understanding about how their seen that on the parallelogram *KLMN*, area *of* ΔKLN = area of ΔNLM; show on parallelogram *POSN, that area of* Δ *PON* = area of ΔNOS; show on parallelogram *RLQO, that area of* Δ *RLO* = area of ΔLQO; and concluded that the area of *CROP* = Area of *OQMS.* Maximum score of these items is 4.

The fourth indicator assess students' skill in generating, exploring, and interpreting the properties of the line formed by the relationship between the diagonal lines, median, and parallel line to the side of the trapezoid. The skill of students' mathematical discovery measured by students' answers in drawing a right-angled trapezoid *ABCD* with the proviso that the trapezoid bracket at point *A*, the length of the side *AB* twice the length of the *DC, and the AB* parallel to the DC; drawing diagonal *AC* and *DB* and mark the intersection point with the name of the point P; draw a line segment *DM, namely median line of* Δ *ADB* intersecting diagonal *AC* at point E; create a parallel line to the sides *AB* and through point *E, thus sequentially intersect line segment* AD, *DB, and BC* respectively at point H, *F, and* G; and concluded relation among $|\overline{HE}|$, $|\overline{EG}|$, and $|\overline{FG}|$.

There are any way students' answers in the first task. Same students did not do anything in this task. Some student just only draw a triangle ABC, tray to draw an isosceles triangle ABC, but did not sign the sides are equal in length, do not draw in accordance with instructions given, did not measure he angles. In the second task, all students are working on this problem and there are many variations of the students' answers. There are students who draw a quadrangle PQRS and not quadrangle ABCD. Students also are drawing the midpoint is not in appropriate area. Few students do not understand the term of midpoint. It can be seen from the students' answers which put the midpoint of both inside and outside the quadrangle. Some of student cannot give incorrect name of quadrangle, for example quadrangle ABDC, PQSR, and PSQR.

There are students who do not work on the third task. Some are trying to calculate the area, although they did not know the length and height the parallelogram presented. Most of the students had not yet understood the symbol of the triangle "Δ" and considers the symbol as a symbol of the angle so that students work on each of these points by drawing angles question. In addition, there is also no mention of extensive relationship as asked, but said the relationship kind of triangle formed. Forth task have maximum score 9. The score reflects the quality of students' work. Most of the students working on this but there also did not finish. There are students who draw a trapezoid that is not in accordance with the instructions given and some are drawing a triangle instead of a trapezoid. There is also a trapezoidal incorrectly named, example trapezoid ABDC. However, there are students who are working on this issue with quite perfect.

According to von Glasersfeld (2000), knowledge can only be derived from experience. Efforts to provide experience with discovery learning aided dynamic mathematical software GeoGebra to gain knowledge of mathematical discoveries can not meet expectations. It is believed to be related to the mastery of basic skills are not yet fully mastered by the student, such as the understanding of the symbols and terms of geometric figures and names and types of those figure. Therefore, efforts to fix this is to construct back (Piaget, 1970) basic knowledge through learning design that has been improved so that the advantages contained in discovery learning can be maximized. An example is to maximize the role of cooperation in groups where individuals can mutually help each other in constructing knowledge through social interaction and culture (Mason & Johnston-Wilder, 2004).

Who have mastered the basic knowledge of students is a necessary condition to make a conjecture by following the instructions presented in the matter properly. Most of the students in this study suggests that they do not follow the instructions given and some others still have problems in the use of writing tools, such as the compass and protractor. Although finding the conjecture is the first step in discovering mathematics (Wu & Chen, 2009) but with modest abilities of the students will cause problems for students to obtain the expected conjecture. Therefore, it is important students master some basic skills and capabilities that the discovering is based on the model of *Geneplore* proposed by Finke can be done.

Analysis of students' skill of mathematical discovery between class taught by discovery learning aided dynamic mathematics software GeoGebra and conventional class on the four indicator of the skill of mathematical discovery indicates that there is no significant difference between the two groups on each indicator of the students' skill of mathematical discovery. Further research interest is to see the extent of the effect on the skill of the qualifying school students' mathematical discovery. The study was motivated by the view that schools with different qualifications usually have a different quality of students. Two groups of school qualifications are tested in this study. Both groups such school is accredited school A and B. The results of analysis show that the skill of students' mathematical discoveries influenced by school qualifications. Further analysis on each group qualifying school concluded that there are significant differences between the skill of the discovery of mathematical students from the experimental class and control class at a school group accredited and there is no significant difference between the skill of the discovery of mathematical students from class the experimental and control groups accredited school B.

Understanding of prior knowledge is used in designing students' Prior Mathematical Skill Test. Understanding of the prerequisites subject expected to affect the final result of learning. Students who already understand the material that will be used as a foundation for understanding the following material is expected to be ready to receive the next material than students who have not mastered. The division of students into groups of three initial capskill level, namely high, medium, and low is expected to determine whether there are significant levels of mathematical skill early on the skill of mathematical discovery. Results of the data analysis concluded that there was significant effect of prior knowledge on students' skill of mathematical discovery.

Results of the data analysis concludes that there is an interaction between learning approaches and school qualifications and there is no interaction between learning approach and prior knowledge; qualifying school and prior knowledge; and learning approaches, school qualifications, and prior knowledge.

Interactions between teaching approaches and school qualifications may be fairly large. When studied further, the interaction that occurs between learning approaches and criteria that the school has a confidence level of more than 99%. Such interactions are expected thanks to the contribution of criteria influence a very large school, which is close to 100%. On the other hand, the learning approach no significant effect on the skill of students 'mathematical discovery at the level of $\alpha = 0.05$, but actually learning approaches affect the skill of students' mathematical discovery at the level of $\alpha = 0.3$. The interaction between school learning approaches and criteria for a conclusion to be expected in this study. Wherein each of these factors are expected to affect the skill of students' mathematical discovery. One factor that strongly affected the criteria for school students' mathematical discovery capabilities. However, it turns learning approach which has been designed in such a way with the development of teaching materials not affect the skill of students' mathematical discovery.

CONCLUSION

Mathematical discovery in this study emphasizes the student's skill to improve its skill to create a simple conjecture. Learning activities are carried out using technology. The reason is because technology allows students to make conjectures and test conjectures they have made (Kuzle, 2013). Moreover, according to Martín-Caraballo and Tenorio-Villalon (2015), mathematical software can be used students in solving a problem, do activities with many examples and doing a test without wasting a lot of time. However, the role these technologies cannot maximize in this study. This is indicated by students' skill of mathematical discovery through discovery learning aided GeoGebra was not different with students' skill of mathematical discovery through conventional learning. The students' skill of mathematical discovery who come from school level A significantly different with that of school level B. In addition, the students' skill of mathematical discovery from the group of students with high level of prior knowledge and medium and low level are significant differences.

There are conclusions about interactions among factors. First, learning approach and the school qualification on the students' skill of mathematical discovery has a significant interaction. Secondly, learning and the prior knowledge on the skill of students' mathematical discovery has no significant interaction. Lastly, learning, qualifying schools, and the prior knowledge on the students' skill of mathematical discovery has no significant interaction.

This study showed that a learning approach or method sometimes was good and successfully applied somewhere. But, sometimes it was not appropriate or suitable to be applied in places, subjects, school levels, or other subject course. Qualification of school which is a standard quality of schools could show its role where quality of student from good schools criteria have better then student quality from the criteria below. Students' prior knowledge can also be used as a reference for measuring the success of learning activities. However, the prior knowledge of students should be more involved in improving student learning outcomes. By knowing prior knowledge of students, teachers can find out various things that have not been understood by students.

Researchers who want to study topic related to technology should consider a few things. The first is the selection method or the appropriate approach to a subject of course and the skill of students to be developed. It requires thinking how to look at the problems faced by students to look for alternative solutions. The second is the allocation of time between activities in the laboratory and in the classroom. More or less time in the lab activities will certainly affect the skill of students to be measured. The learning activities are entirely spent in front of the computer will affect the students' skill or skill in using geometric construction tools, like a ruler, compass, and protractor. One of the recommendations is to evaluate the quantity of learning activities in a computer lab and the skill or skills of students.

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