Implementation of Team-Assited Individualization Instructional Strategies Supported by Geogebra Software to Improve Mathematical Problem Solving Ability

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Abstract: Implementation of team assisted individualization instructional strategies supported by GeoGebra software to improve mathematical problem solving ability. **Objectives:** This quasi-experiment study aims to determine the effectiveness of Team Assisted Individualization (TAI) instructional strategies assisted by Geogebra graphical software to improve students' mathematical problem solving abilities. **Method:** By cluster random sampling techniques, 66 students in grade VIII at SMPN 1 Wundulako were selected as sample. Data collection was carried out using pretest and posttest by applying test and non-test instrument. The data analysis was carried out with descriptive and inferential statistics. **Findings:** The Tukey test results showed that the significance value was 0.005 (<0.05) with the average scores of the experimental and control classes 80.42 and 76.03. **Conclusion:** TAI strategy with graphical software is more effective in improving the mathematical problem solving ability than conventional learning.

Keywords: Team assisted individualization, GeoGebra, mathematical problem solving ability.

Abstrak: Implementasi strategi pembelajaran team assisted individualization berbantukan perangkat lunak GeoGebra untuk meningkatkan kemampuan pemecahan masalah matematis. *Tujuan: Penelitian quasi-experiment ini bertujuan untuk mengetahui efektivitas strategi pembelajaran Team Assisted Individualization (TAI) berbantukan perangkat lunak Geogebra untuk meningkatkan kemampuan pemecahan masalah matematis siswa.* *Metode: Sebanyak 66 orang siswa SMP kelas VIII di Kecamatan Wundulako terpilih sebagai sampel berdasarkan teknik cluster random sampling. Pengumpulan data dilakukan menggunakan pretest dan posttest dengan menerapkan instrumen tes kemampuan pemecahan masalah, observasi aktivitas dan keterlaksanaan pembalajaran. Analisis hasil penelitian dilakukan dengan statistik deskriptif dan inferensial.* *Temuan: Hasil uji Tukey menunjukkan bahwa nilai signifikansi adalah 0.005 (<0.05) dengan skor rata-rata kelas eksperimen dan kontrol berturut-turut adalah 80.42 dan 76.03.* *Kesimpulan: Strategi pembelajaran TAI dengan bantuan software grafis lebih efektif dalam meningkatkan kemampuan pemecahan masalah matematika dibandingkan pembelajaran konvensional.*

Kata kunci: Team assisted individualization, GeoGebra, pemecahan masalah matematis.

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INTRODUCTION

Education is one way to foster talent and self-potential possessed by students. Education makes students become more understanding and responsive to world change as well as the development of Science and Technology. One of the subject that plays an important role in the field of education is mathematics. Mathematics subjects are given to provide students with the ability to think logically, analytically, systematically, critically, creatively and the ability to work together (Schoenfeld, 2009). This competency is needed so that students have the ability to survive in the era of globalization (Zhao, 2011; Schoenfeld, 2009). However, a problem in mathematics learning are less opportunity of students to present their own representations and method (Silver et al., 2005). In addition, sources that can support the learning process of students in a very limited number.

Learning mathematics today must be able to train mathematical problem solving that is needed is very useful to provide students in solving problems in everyday life. Solving these problems as one aspect increases the level of difficulty, as a process of accepting problems and resolving those problems. In addition, problem solving is an intellectual activity to find solutions to problems that are solved by using the knowledge that is already possessed (Schoenfeld, 2014; Jonassen, 2010). Thus, problem solving skills are very important and must be owned by students so that student learning outcomes increase.

Technology and media support students' learning processes and potentially enhance their learning outcomes (Dabbagh & Kitsantas, 2012). The reason regarding the benefits of attractive media in student learning processes includes: 1) Teaching will attract students' attention so that it can foster learning motivation; 2) The material for renewal will be more clearly defined so that it will be better understood by students and allow students to understand the

goals better; 3) The method of teaching will be more varied; 4) Students do more learning activities because they not only listen to the teacher's description but also other activities such as agreeing, doing, demonstrating and others (Bingimlas, 2009). One of them is by using multimedia-based learning media that supports animation.

In addition to learning media, the learning model used in the classroom is also very decisive, one of the learning models that can support learning in the Team Assisted Individualization (TAI) type of cooperative learning model. The TAI learning model is a group learning model that has a guidance strategy between friends (Tinungki, 2015; Awofala, Arigbabu & Awofala, 2013; Nneji, 2011). In this learning, students are given worksheets to be done in groups to enhance the students' concepts. Students are invited to study independently, are drilled to optimize their ability to explore the information sought, drilled to explain their findings to other parties and are drilled to solve problems and use their own representations (Tinungki, 2015). This model is expected to improve students' mathematical representation abilities, mathematics problem solving and students' concept.

On the otherhand, students and teachers are encouraged to implement technology to perform learning in the classroom. By massive development of ICT, every learning subject must be adaptive to technological advances as well as mathematics learning. Ideally, learning mathematics require high accuracy, repetitive concepts or principles, precise, fast and accurate graphic planning. Furthermore, it is very adviced to conduct computer-assisted learning mathematics to improve students' conceptual understanding especially the concepts about geometry transformations, calculus, statistics, and function graphs.

One computer program that can be used as a learning media in mathematics is GeoGebra

software (Markus, 2008). GeoGebra was developed by Markus Hohenwarter, which is a computer program for learning geometry and algebra. By appling TAI model with supported by GeoGebra graphical sofware, it is expected to improve mathematical problem solving abilities of students. Based on the background that has been revealed, this study was carried out to understand an effectiveness of TAI model with GeoGebra software to improve students' mathematical problem solving abilities.

■ **METHOD**

The design of this study was quasi-experimental with the type of pretest-posttest control group design involving two classes, namely the experimental class by applying the TAI model assisted by geogebra software and the control class with conventional learning. The research subjects were 66 people (33 people each in the experimental and control classes) of junior high school students in grade VIII at SMPN 1 Wundulako, District Wundulako, Southeast Sulawesi, Indonesia. The sample selection uses cluster random sampling technique from 183 junior high school students as a population. Hansen & Bowers, 2008) explains that simple cluster sampling is a simple way of taking groups in groups, namely by group randomization. The assumption adopted in this technique, that each group is relatively homogeneous, and random is done on the group. In this study researchers took two classes that had relatively the same mathematical abilities.

Data collection research was conducted using pretest and posttest to measure students' initial and final abilities. The pretest and posttest were performed using an essay-based problem-solving ability test instrument. The research data generated from the pretest and posttest will analyze the gain and normality using the Kolmogorov-Smirnov one-sample test using a significance level of 5%. Furthermore, if the data is declared to be normally distributed then the hypotheses will be tested using a two different test using the one sample Tukey test with a significance level of 5%. Moreover, observations of the activities and implementation of learning are also carried out to determine the achievement of the teacher's ability to manage learning. The teacher's ability to manage learning is the teacher's skill in implementing a series of planned learning activities in the lesson plan.

■ **RESULTS AND DISCUSSION**

The results in this study are elaborated based on the two types of analysis used in the study, namely (a) the results of the descriptive analysis and (b) the results of inferential analysis.

A. Descriptive analysis

Descriptive analysis in this study consisted of analysis of students' mathematical problem solving abilities, teachers', and students' observation.

Analysis of mathematical problem solving abilities

Table 2. Average Ability of Students' Mathematical Problem Solving

Indicators of Problem Solving Abilites	Score			
	Experimental Class		Control Class	
	pretest	posttest	pretest	posttest
Understanding problems	64.2	66.2	63	64.2
Planning	75.6	88.2	73.6	86.4
Implementation	59.4	83.2	56.4	74.6
Review work and interpret solution	23.4	26.2	18.6	24.6

Analysis of mathematical problem solving abilities is intended to provide an overview of the characteristics and differences in ICT assisted learning with conventional learning based on the results of pretest and posttest data. The description of the control class data and the experiment class can be seen in Table 2.

Problem solving ability is the ability that can help students to think analytically in making decisions in everyday life while mathematical problem solving abilities are as one aspect of high-level abilities, as the process of accepting problems and trying to solve the problem. Pretest results of experimental class students based on aspects of problem-solving ability showed good results, on aspects of understanding problems and planning solving abilities of students included in good categories, but on aspects of carrying out problem solving plans and on aspects of checking or drawing conclusions students are still in the less category well. Posttest results of experimental class students based on aspects of problem solving showed very good results, in terms of understanding the problem, determining plans, implementing plans, and re-examining solving or drawing conclusions students are still included in the excellent category. This is because some of the students in completing the calculation questions are not precise and some students do not write the conclusions requested in the problem.

Furthermore, the results of the control class pretest students based on aspects of problem solving ability showed good results, on the aspects of understanding the problem and planning the solving of students' abilities included in the good category, but on aspects of problem solving plans and aspects of checking or drawing conclusions students were still included in the less good category. The posttest results of the control class students based on aspects of problem solving showed that the aspects of

understanding the problem, determining the plan, implementing the plan in a good category, but in the aspect of re-examining the solution or drawing conclusions students were still in the poor category. This is because some of the students in completing the calculation questions are not precise and some students do not write the conclusions requested in the problem.

Analysis of teachers' observation

The teacher observation sheet is used to determine the teacher's ability to manage learning. The results of the analysis of the experimental class observation sheet and the control class can be seen in Figure 2.
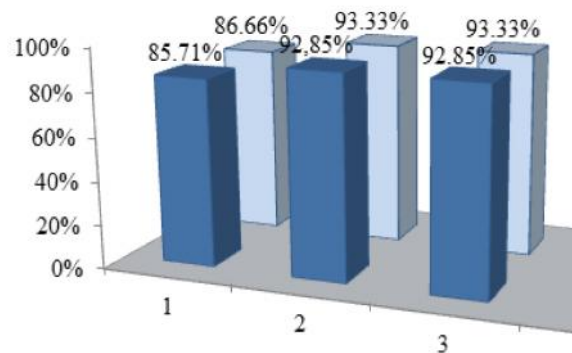

Figure 2. Percentage of teacher activities in experimental class (bright blue) and control class (dark blue)

Based on the results of the analysis of the teacher's observation sheet in the picture above, it can be seen that the percentage of the value of teacher activity in the learning process in the experimental class and the control class has increased. This shows that the teacher is increasingly active in the learning process and has followed the steps of learning according to the mathematical learning model that is assisted by GeoGebra software. Observers' observations of the teacher's ability to manage learning in both the experimental class and the control class, each of the 3 meetings showed that all aspects observed in general were well

implemented. This is because teachers who teach in both classes are the same and in carrying out learning both in the experimental class and in the teacher control class have succeeded in creating a conducive, comfortable atmosphere and encouraging students to be active in the learning process.

The final value of the percentage of teacher activity in the learning process in the experimental class is 93.33%. While the final value of the percentage of teacher activity in the learning process in the control class is 85.71%. From the final value of the percentage of teacher activity in the learning process shows that the teacher's activities in the learning process in both the experimental class and the control class are included in the active category. This shows that in carrying out learning, the teacher is active and has followed the steps of ICT-assisted learning and conventional learning in accordance with its application.

Analysis of students' observation

The observation sheet of student activities is used to determine the activity of students during the learning process. The results of the analysis of the student observation sheet can be seen in Figure 3.
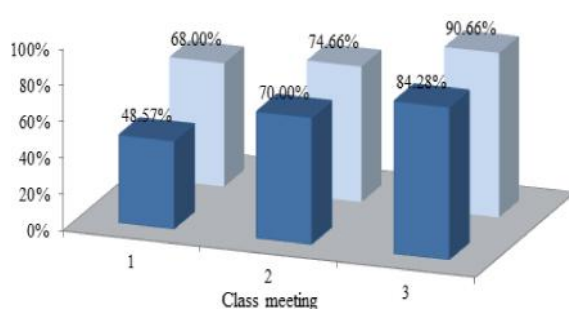

Figure 3. Percentage of student activities in experimental class (bright blue) and control class (dark blue)

Based on the results of the analysis of student activities in the picture above, it can be seen that the percentage of student activity in

the experimental class and the control class has increased. This shows that students are active during the learning process. Observers' observations of the activities of students in the learning process in both the experimental class and the control class, each of the 3 meetings showed that all aspects observed in general were well implemented. Students are enthusiastic in participating in learning, actively interacting, and eager to do the exercises given by the teacher. The final value of the percentage of student activity in the learning process in the experimental class is 90.66%. While the final value of the percentage of student activity in the learning process in the control class was 84.28%. From the final value the percentage of student activity in the learning process shows that the activities of students in the learning process in both the experimental class and the control class are included in the active category.

A. Inferensial Analysis

Before hypothesis testing is carried out, the normality and homogeneity tests are first carried out where the results of this analysis will be used to determine the type of hypothesis analysis method that will be used. Based on the normality test using Kolmogorov-Smirnov analysis and homogeneity test using the Levene test, information was obtained that the sig value> 0.05 for both classes indicated the control class and experiment were normally distributed and homogeneous. Because the sample is normally distributed and homogeneous, the hypothesis analysis technique is determined using two different tests on average with the Independent sample T-test. Based on the analysis, information was obtained that the value of sig = 0. 005 (á <0.05) which means the assisted TAI model of GeoGebra software was more effective in improving students' mathematical problem solving abilities compared to conventional learning.

■ CONCLUSION

Based on the analysis of the results of the research and discussion, it can be concluded that the use of the TAI model assisted by GeoGebra software in mathematics learning can improve students' mathematical problem solving abilities compared to conventional learning. In the TAI model, students will be motivated more actively and participatively in their learning groups, which is reinforced by the use of GeoGebra graphics software that trains representation and problem solving based on graphical information provided by sofware.

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