

The effect of GeoGebra-assisted interactive learning on student mathematical achievement of coordinate system

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ABSTRACT

This present study aims to examine the effect of GeoGebra-assisted interactive learning on student mathematical achievement of coordinate system. The study applied a quasi-experimental method that included 41 fifth grade students from a private Islamic school in Pekanbaru, Riau. The students were randomized into an experimental group (n=21) that received GeoGebra-assisted interactive learning and a control group (n=20) that received traditional teaching approach. Student mathematical achievement was measured using items of coordinate system developed by the researchers, and the data gathering in this study was analyzed using nonparametric statistical analysis. The findings indicated that there was significant statistical difference in student mathematical achievement of coordinate system between the experimental and control group (Asymp. Sig. (2-tailed) = 0.000 < 0.05)). The study concluded that the instruction based on GeoGebra-assisted interactive learning had a statistically significant positive effect on improving student mathematical achievement of coordinate system.

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INTRODUCTION

Mathematics is one of several subjects that can give us advantages in our lives. By learning mathematics students are expected to acquire advantages that they can implement in their real life. One of the topics of mathematics that can be applied in real life is the coordinate system (Altay et al., 2017). The coordinate system is an important topic of geometry that should be taught and understood. The coordinate system can help humans to determine a position of an object easily and precisely (Palupi, 2013; Palupi et al., 2013). It can not be denied that humans can find and implement the concept of the coordinate system everywhere, for instance in a simple thing such as sitting arrangement in a class, finding a certain book in a library, and finding a

location using a map. This indicates that the coordinate system is everywhere and rich in context. Referring to this matter, students need to learn the coordinate system.

In Indonesia, the coordinate system has been taught to students since elementary school. However, to teach this topic there are some difficulties, such as students tend to reverse axis x and y, students also tend to reverse to plot point x and y, and hard to visualize the coordinate system (Wijaya et al., 2018). Therefore, to teach the coordinate system, teachers need a certain way of teaching which can evoke students' knowledge about the coordinate system. An approach teaching that can be used to teach this topic is interactive learning. Interactive learning can stimulate students to be more courageous in communicating their curiousness regarding the concept of the topics they learn (Aleven et al., 2003; Barker, 1994; Henkel, 2010; Iranti et al., 2023). In the implementation of interactive learning in teaching mathematics should be supported using interactive and interesting learning media. This is because to teach abstract mathematics a learning media is needed to present visual experiences to students (Boakes, 2009; Putra et al., 2022 Yilmaz & Argun, 2017).

The form of learning media that is suitable to create interactive learning is GeoGebra. GeoGebra can assist teachers to visualize the concept of mathematics in an interesting way (Bozkurt & Ruthven, 2017; Putra et al., 2021). Combining GeoGebra into an interactive learning can be a good way of learning to help students increase their understanding in geometry material such as the coordinate system because to learn geometry like the coordinate system requires visualizing abilities. A number of studies have found that technology has a positive impact for helping students to develop their visualizing abilities which cause them to get a good learning achievement (Saha et al., 2010). Some previous studies also have showed that GeoGebra learning instruction can increase students' mathematics achievement (Bulut et al., 2015; Kabaca, 2013). Hence, GeoGebra can also be used as a media to assist teachers to teach the coordinate system to students. Therefore, the researchers are interested in conducting a study to find the effect of GeoGebra-assisted interactive learning on students' knowledge about the coordinate system especially for elementary students in the fifth grade.

THEORETICAL FRAMEWORK

Interactive Learning

Interactive learning is a process in learning activity that allows students to be actively involved in the whole process of learning, both physically and mentally (Mitrawilda, 2018). Interactive learning refers to the interaction construct between students and a teacher or students with the source of learning/media (Begum & Lakshmi, 2023). Interactive learning can be interpreted as learning that can make the knowledge received by students more meaningful. This learning includes student center learning not only teacher-centered, giving rise to two lines of interactive communication between a teacher and students, and among students (Tanga & Luggya, 2022; Winanda et al., 2020).

Interactive learning is a learning that focuses on well-built interactions for everyone in learning activities. The teacher is expected to be able to build interaction between himself and every student in the class, to build an effective, conducive, and active environment (Morcom, 2022). According to several definitions related to interactive learning, the researchers conclude that interactive learning is learning that refers to interaction in learning activity among students, a teacher, and learning media which also contributes to build an active learning environment.

To conduct interactive learning in class, a teacher should know the stages of interactive learning. According to Majid (2014), there are seven stages of interactive learning namely;

preparation, prior knowledge, exploring/activity, students' questions, investigation, final knowledge, and reflection. Preparation, in this stage the teacher collects various resources of learning that will be applied in the learning process, for instance, what media will be applied in the learning process to support learning activities. In this stage, the teacher also gives an apperception. The apperception conveyed by the teacher is a brief description related to a certain topic, or it also can be in the form of the teacher giving the opportunity for the students to retell the topic that has been studied in the last meeting.

Prior knowledge, in this stage the teacher explores students' initial knowledge about what students already know regarding the topic they will learn. Exploring students' knowledge can be done by giving a question or a problem relating to the topic, then the teacher asks students about their opinion. Prior knowledge of students can be used as a benchmark to compare students' prior knowledge with students' knowledge after carrying out a learning activity. The next stage of interactive learning is exploring/activity, this is a stage to stimulate students' curiosity. To generate students' curiosity the teacher can do some activities such as demonstration, asking questions to the students and representation of a phenomenon through videos or pictures.

Students' questions. In this stage students are given the opportunity to ask a question. Students might find difficulties to ask a question, thus the teacher needs to encourage and guide the students to give a question. The teacher should select the questions that are related to the topic. Investigation, in the investigation stage interactions arise between students and teachers, students with students, as well as interactions between students with media of learning. In this stage, students could find out the concept of a topic by activities of collecting, organizing, and analyzing data on activities planned by the teacher. The teacher encourages students to determine the answer to a problem.

Final knowledge. In this stage, the students present their work. The teacher guides students in the class discussion. In this stage teacher also can compare students' prior knowledge with students' knowledge after investigating. The last stage of interactive learning is reflection. The students reflect or rethink what they have learned. The teacher gives time for the students to digest or discuss with themselves. In this stage, students are encouraged to be able and courageous to tell their opinions related to everything that is obtained from learning activities.

GeoGebra as an Interactive Learning Media

GeoGebra is a dynamic software designed by Markus Hohenwarter that can be used as a tool or media to learn mathematics (M Hohenwarter, 2007). GeoGebra serves various of interfaces of mathematical concepts for teaching and learning such as algebraic view, graphics view and spreadsheet view (Baye, 2021). GeoGebra also known as an interactive mathematical software that is essential for school to university level to foster mathematical discoveries and experiments (Dahal et al., 2019). GeoGebra provides an interactive learning environment and provides students to share their knowledge and creative work in mathematics (Killogjeri & Shyti, 2010). The use of GeoGebra can help students to articulate their visual, analytic thinking, and understanding in the learning process (Takači et al., 2015). Different research study revealed that GeoGebra can help to make mathematics classroom interesting through mutual interaction of teachers and students (Hernández et al., 2020; Putra et al., 2021; Tatar & Zengin, 2016).

GeoGebra offers a wide range of math-learning activities, such as teachers can utilize GeoGebra as a tool for visualization and presentation of specific mathematical ideas, as well as a construction help (Solvang & Haglund, 2022). GeoGebra can be used as a tool for the discovery process. GeoGebra helps to illustrate a construct of mathematical concepts, such as building the

outside and inner circles of a triangle or building tangents (Azizah et al., 2021). Students can use GeoGebra to find a mathematical topic, such as the location of the points or the properties of a parabola (Markus Hohenwarter & Fuchs, 2005). GeoGebra software can help students grasp better mathematics knowledge (Bulut et al., 2015). Additionally, GeoGebra is capable of facilitating the abstraction process from the relationship between geometric models and algebraic models (Aktümen & Kabaca, 2012). GeoGebra can also help students in investigating and representing geometry. Based on the explanation that has been conveyed which GeoGebra has many benefits in learning mathematics, in this study researchers integrated the use of GeoGebra at the stages of interactive learning.

Coordinate System

The concept of precisely representing the placement of points on the plane and later in space was initially proposed by the French mathematician and philosopher René Descartes (1596-1650) (Descartes & Cress, 1998). Descartes, whose name is pronounced "Cartesius" in Latin, is the source of the "Cartesian Coordinates System" (Levenberg, 2015). The Cartesian Coordinates System is defined by two straight lines called axes which are typically positioned at a right angle, serve as the basis for the Cartesian Coordinates System. X and Y stand for the horizontal and vertical axes respectively. The origin of the axes is the place at where both axes connect. The values of the X and the Y on the point are indicated in order to represent a specific location on the axes system, providing an ordered pair of numbers (X, Y). The expression "Cartesian Coordinates System" serves only in 2 and a 3-dimensional space. Modern mathematics and analytical geometry were made possible by this system. Without the use of the Cartesian Coordinates System, several mathematical advancements and their application are impossible to envision (Levenberg, 2015). Hence, the coordinate system is an important subject to learn in mathematics, we should start to learn and teach the coordinate system.

In Indonesian curriculum, coordinate system is taught in the fifth grade. The basic competency of elementary school mathematics coordinate system material is to recognize and draw the location plan of objects and coordinate systems (Kemdikbud, 2013). From the basic competency, students are asked to know the x and y lines, abscissa, and ordinate points, to coordinate points. Based on this basic competency, several indicators are derived, namely; 1) Students know the components contained in the coordinate system, 2) Students know how to determine and analyze coordinate points, and 3) Students can draw coordinate points from the abscissa and ordinate that have been determined.

To teach coordinate system material, teachers need learning tools or media that can visualize the material well. With the availability of the right media or equipment, teachers can provide opportunities for students to explore the material and increase their knowledge. In this study the coordinate system is visualized using the help of GeoGebra applets to present the coordinate system to be more interesting for students to learn.

METHOD

Study Design

This study aims to discover the effect of GeoGebra-assisted interactive learning on students' knowledge about the coordinate system. This study used the quasi-experimental method. Quasi-experimental research used to examine the impact of the independent variable on the dependent variable (Creswell & Creswell, 2017). The design of this study was non-equivalent control group design. This design allows the researchers to give pretest and posttest to the experiment and

control group. The researchers give the treatment only to the experiment group, to see the differences of both group (Creswell & Creswell, 2017) . This design of this study is presented in Figure 1.

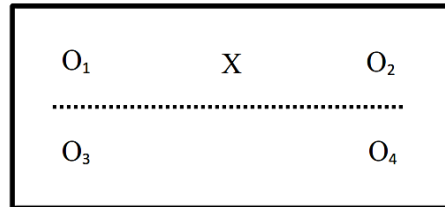


Figure 1. Nonequivalent control group design

The researchers conducted this study in two different classes. The first class as an experimental class taught using GeoGebra-assisted interactive learning (X). The second class as a control class taught using conventional approach. After pretest and posttest conducted, the researchers analyzed the data using Mann Whitney test to compare and determine the result of the research.

Research Instrument

The research instruments in this study were tests of student coordinate system knowledge and learning devices. The number of questions prepared before being tested for validity was 30 multiple choice questions about the coordinate system. However, after testing its validity using IBM Statistic 20, 24 valid questions were obtained. After being tested for validity, the valid questions were tested for reliability. The reliability was estimated by Cronbach Alpha using IBM Statistic 20. The results of the reliability test obtained data that the questions have a high level of reliability with a reliability value of 0.908. Eventually, the researchers decided to use only 20 questions as the instrument of this study.

The 20 questions used in this study have been divided based on the indicators of the coordinate system. Two questions aimed to measure students' knowledge about the components of the coordinate system. Eleven questions aimed to measure students' ability to determine and analyze the point on the coordinate plane. The other seven questions were measuring students' ability to draw a point on the coordinate plane from the lines called x (abscissa) and y (ordinate). Taking this number of questions has also been adjusted to the level of difficulty of the questions and the test of different items. Research instruments in this study other than test questions are learning devices consisting of lesson plans and student worksheets that have been adjusted to the coordinate system material.

Data Collection

To collect data, the researchers conducted tests as research methods. The test method used in this study applied pre-test and post-test to the experimental class and control class. After giving the pre-test to both classes, the next step is to give treatments. In the experimental class, GeoGebra-assisted interactive learning was given, while the control class was given conventional learning treatment. After the researchers gave the treatment, the post-test was then carried out to the experimental class and control class.

Data Analysis

The data analysis technique used was statistical description, prerequisite test (normality and homogeneity test), and hypothesis test. Statistical description is a process to analyze the data in the form of tabulation to make it easier to understand and to interpret (Sugiyono, 2019). The data normality was checked using the Shapiro Wilk test through IBM SPSS Statistic 20 with asymp sig in 0,05. The data homogeneity was also checked through IBM SPSS Statistic 20. When the result of prerequisite test has gained, then the researchers conducted the hypothesis test to determine whether there is a significant difference between the experimental and control classes. The researchers used IBM SPSS Statistic 20 to test the hypothesis.

RESULTS

The Learning Implementation Process

The researchers implemented GeoGebra-assisted interactive learning to the experimental class, while for the control class the researchers conducted learning using conventional methods. In the following, the researchers describe the learning implementation in the experimental class.

The example presented here is the application of learning at the third meeting on drawing coordinate systems.

Preparation

At this stage the teacher has previously prepared a lesson plan that guides the implementation of learning. To start the class, the teacher says greetings and checks the presence of students. The teacher conducts apperception before starting the material that the students will learn. The teacher also informs students about the activities and materials that students will carry out such as, "*In today's lesson we will discuss how to draw a coordinate system*".

Teacher-student interaction arises when the teacher says greetings and checks the students' attendance, when the teacher gives apperception, and conveys what learning will be learned to students.

Prior knowledge

In this activity, the teacher asks students about the material of learning to find out the extent of students' prior knowledge before carrying out further learning. By knowing students' prior knowledge, teachers can evaluate learning achievements related to coordinate system material at the end of the learning process. For instance, the teacher asks students "*does anyone know how to draw a coordinate plane?*". Then from this question there was a student (S1) who answered, "*using a ruler*". The teacher then asked the students again, "*(what does it mean) using a ruler? What should we do first?*". Then the student (S1) again answered, "*draw the x-axis and y-axis*". At this stage, the activity between the teacher and students indicates that there is a mutual interaction between teachers and students.

Exploring/Activity

At this stage, the teacher arouses students' curiosity by encouraging students to carry out demonstration activities related to coordinate system material with the help of GeoGebra applet. At the first meeting the teacher asked students to run the GeoGebra applet related to the components of the coordinate system. At the second meeting the teacher directs students to

operate the GeoGebra applet about determining and analyzing coordinate points. While in the third meeting the teacher encourages students to draw flat shapes formed from coordinate points with the help of GeoGebra applets. To carry out the activity stages at each meeting, students are divided into 4 groups.



Figure 2. Students operate the GeoGebra applet

At this phase there is interaction between students and teachers, students and students, and students with GeoGebra applets. Student interaction with the teacher is created when the teacher explains to students about how to run activities in the GeoGebra applet. As we can see in the figure 2 student interaction with students occurs when students work together to operate the GeoGebra applet with their group members. Students working together to figure out what plane figure is shaped by some points of the coordinate (Figure 2). Meanwhile, student interaction with the GeoGebra applet occurs when students directly work on coordinate system activities in the GeoGebra applet.

Students' question

At this stage the teacher guides students to be able to give questions related to the coordinate system material. Students in groups provide one question that will later be answered by other groups. At this stage the second group asked, "*How to determine the coordinate point?*", students from the first group tried to answer the question given "*by drawing a line from the y-axis to the x-axis*". Then there was another student from group four who responded to the question "*draw a line from one point to the next point*". To straighten out the answers given by the students, the teacher summarized the answer "*so, how to determine the coordinate point is seen from the x-axis to the y-axis*".

There was interaction between the teacher and students and students with students at this stage. Teacher-student interaction occurs when the teacher calls on students to give and answer questions given by students. Student to student interaction occurs when students with their groups discuss with each other to find or provide questions.

Investigation

In this activity the teacher instructs students to be able to work on the student worksheet with their group. The worksheet given contains coordinate system problems that must be solved by students in groups to cause student interaction with students (Figure 3).



Figure 3. Students solve the problem in the worksheet

In Figure 3, students are seen in groups working on the worksheet given by the teacher. Students are working on problems about drawing coordinate points and seeing what flat shapes are formed from coordinate points. Based on the results of student work on the problems given, the four groups can work on the problem well. All four groups can solve the problem well. The way they solve the problems in the worksheet is by discussing and cooperating with fellow group members, and occasionally looking at the GeoGebra applet to check the suitability of the coordinate system they are working on.

At this stage, interaction is established when students and their group members work together in completing the worksheet so that interaction between students and students is formed. The interaction between the teacher and students is created when the teacher monitors and guides students to solve the tasks on the worksheet. Moreover, student interaction with GeoGebra applet is created when students see examples and try to adjust the coordinate system they are working on.

Final Knowledge

After students work on the worksheet in groups, the next activity is the teacher urges students to do a presentation in front of the class. At this stage, the teacher can also see the comparison between students' prior knowledge and students' final knowledge after carrying out the investigation. Student-to-student interaction occurred when students do a presentation in front of the class. When one of the groups (Group 1) did a presentation, the teacher asked other students to pay attention to the work of the group that was presenting. Other students were allowed to give questions or responses to the presenting group.

An example of the form of interaction at this stage can be seen in the third meeting learning when a student (Group 3) gave a response to the results of the discussion of the group that was presenting, "*for the question number 3, we have different flat shape*", A student conveyed the differences he found in problem number 3 in the worksheet (Figure 4). Then group 1 who was presenting re-presented the answers they got while explaining the answers found by the group, to straighten out the correct answer the teacher encouraged students to find out the right answer "*so what is the right answer*", the students then answered "*rhombus*". In figure 4 we can see that group 1 answered a kite as the shape that is formed by the coordinate points, meanwhile group 3 found a rhombus as the answer. The difference in the answer to group 1's answer is because the distance between the numbers on the coordinate axis is not the same, resulting in an inappropriate image (Figure 4).

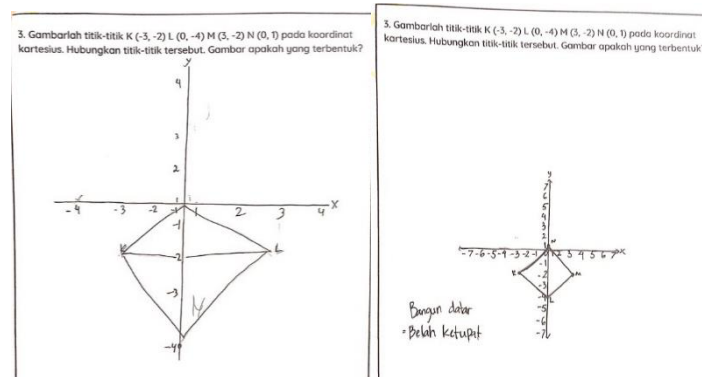


Figure 4. (a) The answer of group 1 (b) The answer of group 3

From the activities at the final investigation stage, there was interaction between the students who were presenting and the other students who were in the audience. Teacher interaction with students is present when the teacher gives directions to students when conducting presentations and class discussions.

Reflection

The final activity of interactive learning is reflection. In this stage, the teacher asks the students to reflect on what they have learned. The teacher encourages the students to give their conclusions or opinions on the learning that they have participated in. The teacher asks the students "So we have learned about coordinate components, determining coordinate points, and drawing coordinate planes. Now, does anyone want to give a conclusion?", a student (S1) gives his conclusion "The conclusion is that coordinates have components, namely quadrant 1, quadrant 2, quadrant 3, quadrant 4, x-axis, y-axis, center point. Then it turns out that the coordinate points can form a flat shape and we have learned the coordinate system".

From the excerpt of the conversation between the teacher and students, an interaction between the teacher and students at this stage is present when the teacher invites students to provide conclusions and together with students reflect on the lessons that have been followed.

Meanwhile, the control class conducted conventional learning with the three stages, introduction, core, and closing stage. The researchers provide a brief explanation to each stage as follows:

Introduction stage

At this stage, the teacher greeted the students and checked their attendance. The teacher asked the students' readiness to learn and delivered apperception which was related to the coordinate system material. The teacher informs students about the material that will be learned at each meeting.

Core stage

At this stage the teacher begins to explain to students related to coordinate system material. At the first meeting the teacher explained the material on the components of the coordinate system, the second meeting the teacher explained the material on determining and analyzing the location of the coordinate points, and the third meeting the teacher explained drawing the coordinate plane

and flat shapes formed from coordinate points. When the teacher explains, students are asked to pay attention to the teacher.

When explaining the coordinate system material, the teacher also gave some example problems and asked one of the students to come forward to the front of the class to work on the example problems given. After the teacher finished explaining the coordinate system material to the students, the teacher urged the students to do the exercise questions in the book.

Closing stage

The last activity of the learning stages in the control class is the teacher encourages students to be able to conclude what has been learned. After that the teacher closes the lesson by saying greetings.

Descriptive Analysis

The data in table 1 shows the outcomes of a descriptive analysis that was performed using IBM SPSS 20 to describe research data, including the quantity of data, minimum value, maximum value, average value, and standard deviation.

Table 1. Results of descriptive analysis

	N	Minimum	Maximum	Mean	Std. Deviation
Experimental Pre-test	21	25	70	44.05	11.025
Experimental Post-test	21	65	100	80.95	8.158
Control Pre-test	20	15	60	37.25	13.226
Control Post-test	20	50	80	67.50	8.660
Valid N (listwise)	20				

Table 1 shows a summary of the result of descriptive statistical analysis of experimental class and control class. The mean of post-test in the experimental class (80.95) after being given the GeoGebra-assisted interactive learning treatment is greater than the mean of post-test owned by the control class (67.50).

Normality and Homogeneity Test

Table 2 shows that the results of the normality test of the two classes in the pre-test section have a significance value greater than the significance level (0.05), which means that the data is normally distributed. Then in table 3, after the homogeneity test is carried out, the significance value of experimental and control class (0.791) is greater than the significance level (0.05), therefore the experimental class and control class have homogeneous variants.

Table 2. Normality test

Class		Shapiro-Wilk		
		Statistic	df	Sig.
Experimental	Pre-test	0.950	21	0.399
	Post-test	0.966	21	0.634
Control	Pre-test	0.946	20	0.316
	Post-test	0.899	20	0.040

Table 3. Homogeneity test

			Levene Statistic	df1	df2	Sig.
Result of coordinate system test	Based on Mean		.071	1	39	.791
	Based on Median		.011	1	39	.919
	Based on Median and with adjusted df		.011	1	36.995	.919
	Based on trimmed mean		.051	1	39	.823

Analysis of hypothesis

A hypothesis test is then performed based on the outcomes of the prerequisite test to determine whether the experimental class differs from the control class. The t-test was used in this study to conduct the hypothesis test (Table 4).

Table 4. Results of t-test

			t-test for Equality of Means		
			t	df	Sig. (2-tailed)
Result of coordinate system test	Equal variances assumed		5.122	39	.000
	Equal variances not assumed		5.114	38.537	.000

Table 4 shows the results of hypothesis testing using the t-test on the post-test of the experimental class and control class. Based on the results of the t-test, a significant value of 0.000 was obtained. The significant value of 0.000 is smaller than the significant level of 0.05. Hence, it can be said that there is a significant difference in the results of coordinate system knowledge in the experimental class that applied GeoGebra-assisted interactive learning with the control class that used conventional learning. Based on that result it also can be known that GeoGebra-assisted interactive learning has a significant effect on students' coordinate system knowledge.

DISCUSSION

This study was conducted to determine the effect of the application of GeoGebra-assisted interactive learning on the knowledge of coordinate system of grade V elementary school students. The implementation of this research is based on the problems encountered in previous studies that teachers are constrained in delivering coordinate system material because students are often reversed in positioning the x and y point values and find it difficult to visualize the coordinate system (Wijaya et al., 2018). Referring to this, the researcher conducted a study to help students understand and visualize the coordinate system and assist teachers in teaching the coordinate system to students. The solution provided is to implement interactive learning assisted by GeoGebra applets in learning the coordinate system. The results of this research can later be a reference for teachers in providing interesting learning to students about coordinate system material.

The result found from this study indicates that GeoGebra-assisted interactive learning has an effect on the coordinate system knowledge of fifth grade of elementary school students. The coordinate system knowledge of the students increased significantly after the implementation of interactive learning assisted by GeoGebra applets in the experimental class. The increase in coordinate system knowledge in the experimental class can be seen from the average pretest and posttest where the experimental class pretest average was 44.05 and the posttest average was 80.95. The increase in the average value of the experimental class was higher than the control class with an average value of 37.25 in the pretest to 67.50 in the posttest. To test the hypothesis, t-test was conducted with a significance value of $0.000 < 0.05$ (Table 4), which means that GeoGebra-assisted interactive learning has a significant effect on the knowledge of coordinate systems of fifth grade of elementary school students.

The significant increase in students' coordinate system knowledge in the experimental class was due to the implementation of interactive learning activities that build interaction between students and students, students and teachers, and students with GeoGebra applets. Student activeness in learning activities is more created by using the help of GeoGebra applets. In addition, the use of GeoGebra applets in mathematics learning also attracts students' attention to learning activities and makes them focusing their attention on the coordinate system activities in the GeoGebra applet (Dikovic, 2009). Learning mathematics with GeoGebra increases student activeness and enthusiasm more than with conventional learning. The help of the GeoGebra applet in learning the coordinate system can make it easier for students to understand the components of the coordinate system, determine the coordinate points, and draw the coordinate system.

The improvement factor can be categorized as a form of the advantages of GeoGebra-assisted interactive learning. The advantages can be seen from the interactive learning assisted by GeoGebra applets that can foster student enthusiasm, create an interactive and interesting

learning atmosphere. Not only does it help generate active interaction, student enthusiasm, and create interesting learning, GeoGebra can also make it easier for students to visualize the mathematical concepts learned, namely coordinate system material. This is in accordance with the statement by Dahal (Dahal et al., 2022) that GeoGebra can help visualize geometry transformations and create a better understanding of mathematics learning. Then it is also supported by the results of research conducted by Alhkateeb and Al-Duwairi (Alkhateeb & Al-Duwairi, 2019) which examines the effect of using mobile applications such as GeoGebra on student learning outcomes in geometry learning where the results of the study are the use of GeoGebra provides opportunities for students to interact directly with learning content/materials and contributes to improving student learning outcomes. A similiar finding also found by a study conducted by Saha (Saha et al., 2010) which show that by using GeoGebra as a supplement to a classroom instruction is more effective to enhance students learning and understanding rather than traditional instruction alone.

CONCLUSION

This study has revealed that GeoGebra-assisted interactive learning give an effect to students' knowledge of the coordinate system. It can help fifth-grade students to understand more about the concept of the coordinate systems. Based on the post-test results of the experimental and control classes, it was found that the average post-test of the experimental class (80.95) was higher than the control class (67.50). The effect of GeoGebra-assisted interactive learning also can be seen from the results of testing the t-test hypothesis obtained a significance value of 0.000 which means $0.000 < 0.05$ which indicates that there is a significant difference of the experimental and control class. So, it can be concluded that the application of GeoGebra-assisted interactive learning gives effect to students' knowledge of the coordinate system and also can increase the knowledge of the coordinate system of fifth grade of elementary school students.

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