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IMPROVING STUDENTS LEARNING OUTCOMES ON CIRCLE EQUATION MATERIAL USING GEOGEBRA SOFTWARE

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Abstract. This study aims to describe learning using GeoGebra software on circle equations material that can improve students learning outcomes of class XI MIPA5 SMAN 1 Mengwi. The research method used is class action research which consists of four stages, namely planning, implementation, observation, and reflection. The subject of this study is all students of class XI MIPA5 SMAN 1 Mengwi, while the object of research is the entire process and results of mathematics learning using GeoGebra software on circle equation material as an effort to improve students learning outcomes of the class. The data collection techniques used are observation, interviews, and tests. This research is carried out in two cycles. The results show that the application of mathematics learning using GeoGebra software on circle equations material can improve the learning outcomes of class XI MIPA5 SMAN 1 Mengwi students. This is shown by the average student learning outcomes in the final test I, which is 83 with a classical completion percentage of 75% increasing to 90 in the final test II with a classical completion percentage of 89%.

INTRODUCTION

PISA (Programme for International Student Assessment), an international assessment to measure the ability of 15-year-olds in reading, mathematics and science, in 2018 shows that Indonesia's mathematics score is relatively low, ranking 72 out of 78 countries. Trends in International Mathematics and Science Study (TIMSS), which is an international study of trends or developments in mathematics and science, in 2015 also depicts less encouraging results because Indonesia ranks 46th out of 51 countries. This indicates that learning in Indonesia is still not optimal in developing students' mathematical skills. Mathematics is one of the most important subjects in life and should be taught at all grade levels (Wijaya, 2012). But until now there are still many students who feel that mathematics is a difficult and unpleasant subject (Sumantri, 2015). Mathematics learning still needs to be perfected by mathematics teachers, so that students are able to achieve optimal learning outcomes. In addition, mathematics learning technology also needs to be optimized in order to increase students' competence in the field of information technology (Sumandya & Widana, 2022).

Based on the results of students interviews conducted on grade XI MIPA5 of SMA Negeri 1 Mengwi, they had difficulty in understanding mathematics lessons, especially in geometry & algebra materials such as circle equations. From the observations, it was also found that

the learning carried out in class was only limited to the presentation of material using powerpoint and related to learning that required graphic illustrations, both in geometry and algebra learning, teachers rarely used computers, most of the material explanations were presented with markers and whiteboards. The graphical representation on the whiteboard was of course static, so the role of a parameter (coefficient) of a mathematical equation could not be explored freely. As a result, the effect of the coefficient on the graph of the equation was difficult for students to understand.

Ramayulis (2015) stated that the main problems of education are problems of educational practices, educational equity, quality of education because educational results have not reached the expected level, educational efficiency and relevance of education. In order to improve the quality of education and students' mathematical abilities, new innovations in learning are needed. According to Firdayati (2020) in learning, teachers should always innovate to be able to motivate students' interest in learning and improve the quality of learning with varied learning models and appropriate teaching aids. One of the innovations in education is the use of media & technology in the learning process. According to Arsyad (2015), learning media is a tool for evaluating learning so that it can help students increase student motivation, interest in learning, and increase understanding, as well as being able to present data interestingly, reliably, and condense information. The use of learning media is a part that must get the attention of educators (teachers) in the learning process. The use of technology in the learning process, especially computer science, makes it easier for educators or teachers to explain an abstract learning material and easy to understand so that it can avoid student argumentation (Cahyo, 2013).

The use of technology in learning in the form of computer application media or software is expected to attract attention and overcome student learning difficulties in learning mathematical material that requires visualisation, for example through the use of GeoGebra software in mathematics learning (Sudarsana, 2021). GeoGebra is a computer program (software) used for learning mathematics, especially Geometry and Algebra. The use of GeoGebra can change the learning of Geometry to be more interesting because it is able to visualise abstract objects into concrete (Pranawestu et al., 2012). The use of geogebra can provide several advantages, including: (1) producing geometric paintings quickly and carefully compared to using pencils, rulers or ranges; (2) providing a clearer visual experience to students in understanding geometry concepts because it is equipped with animation and manipulation movements (dragging); (3) being used as a reversal/evaluation to ensure that the painting that has been made is correct, (4) making it easy for students to investigate or show the properties that apply to a geometric object. Widyaningrum & Murwanintyas (2012) state that with computer-based learning, students will more easily understand abstract concepts, which can improve learning outcomes in the end. Learning outcomes are a reflection of students' mathematical abilities. Learning outcomes are basically the final results that are expected to be achieved after a learning (Sarmiati et al., 2019).

In the era of the industrial revolution 4.0, student success in the future is greatly influenced by mastery of information technology (Putri Sri Devi et al., 2022). All aspects of life cannot be separated from information technology. Therefore, in classroom learning, teachers should make optimal use of information technology, so that students indirectly learn through their own experiences to solve the given problems. Habituation in the use of information technology can be done by teachers through learning and assessment. Thus, training in the use of information technology can be carried out indirectly (Widana & Ratnaya, 2021). The use of information technology can also have an impact on student behaviour as a provision

for life in the future. This is important for teachers to know, so that teachers are enthusiastic and continue to work to increase active student involvement in information technology-based learning (Widana, 2023).

Based on the description of the problem above and seeing several opinions related to the importance of technology & media in learning, it is seen urgent to conduct a research to improve students learning outcomes on circle equation material using GeoGebra Software. This research is supported by research conducted by Mayadi (2021) that shows that the use of GeoGebra learning media in learning trigonometric function graphs can increase student activeness and learning outcomes. Farihah (2020) in her research also reveals that the motivation and learning outcomes of students who use the GeoGebra interactive program are higher than students who do not use GeoGebra.

METHOD

The type of research used is classroom action research. The action taken was in the form of using GeoGebra software in mathematics learning on circle equation material as an effort to improve the learning outcomes of grade XI MIPA5 students of SMAN 1 Mengwi. This research was conducted at SMAN 1 Mengwi, Badung, Bali and began on January 30, 2023 to February 2, 2023. The subjects of the study were students of grade XI MIPA5 SMAN 1 Mengwi in the academic year 2022/2023. The object of research was the entire process and results of mathematics learning with the application of learning using GeoGebra software on circle equation material as an effort to improve the learning outcomes of students in that class.

This research procedure was based on the classroom action research model developed by Stepen Kemmis and Robin McTaggart. One cycle consisted of 4 stages, namely planning, acting, observing, and reflecting which was then followed by the next spiral cycle. The following is a picture of the cycle model according to Kemmis and McTaggart.

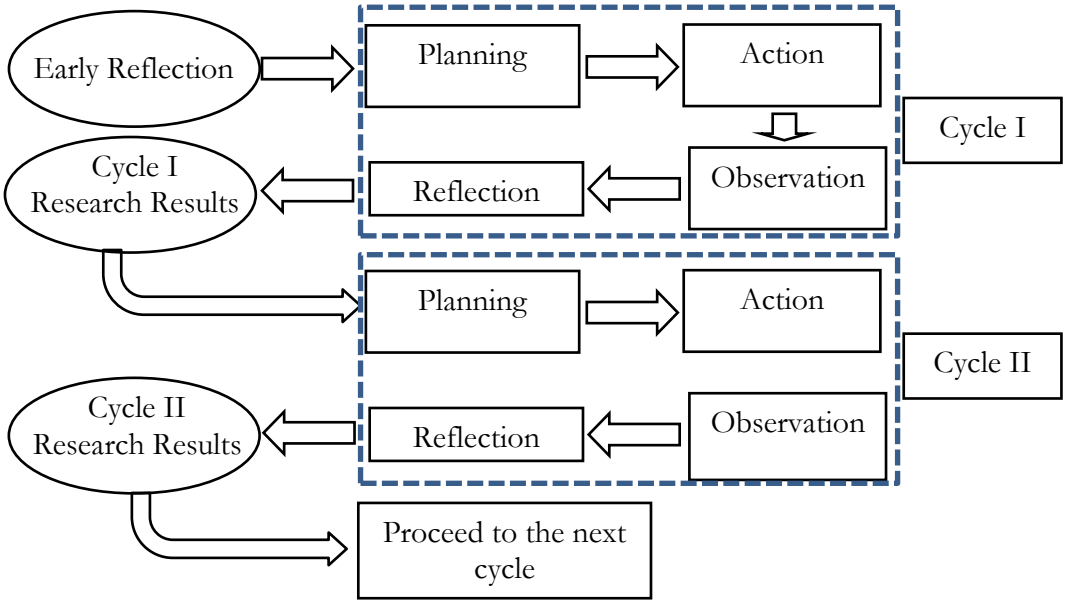

Image 1. CAR Cycle Model according to Kemmis and McTaggart

This research was carried out in 2 learning cycles. Each cycle consisted of one meeting. In cycle I, mathematics learning was applied using GeoGebra software. After learning, students were given a final test I to determine the completeness of student learning outcomes which were then used as a reference for improvement to carry out cycle II. After the second cycle, students were given a final test II to determine the completeness of learning outcomes which would then be used as a comparison between cycle I and cycle II.

Data collection techniques in this study were through observation, interviews, and tests. Observation aimed to determine the implementation of learning using GeoGebra software. Interviews were conducted as a medium to explore more about things that could not be known through observation and to find out students' responses to the learning carried out. The instruments in this study were learning observation sheets, interview guidelines, and learning outcomes tests. The data analysis technique used in this study was descriptive analysis with detailed analysis, namely: (1) observation data using percentage tabulation, (2) test data using the percentage of achievement of the standard score. This research was said to be successful if it met the following success criteria: (1) the minimum average score was equivalent to the standard score for mathematics of 80, (2) classical completeness of at least 85%. If one or both were not met then the research continued to the next cycle.

RESULTS AND DISCUSSION

Initial reflection is done first to obtain information about how the teacher's actions and student activities in learning. Based on the results of initial observations and interviews with subject teachers and students, information is obtained that so far teachers have not been optimal in utilising media & technology in learning. In geometry and algebra lessons that require illustrations, teachers often draw them on the whiteboard only with markers. This has an impact on students who become difficult to understand the lesson, especially on the material of circle equations. This condition needs to be immediately solved so that student understanding and student learning outcomes can improve. After discussing with subject teachers and considering various things, it is finally agreed to use GeoGebra software in learning circle equations.

This research is carried out in two cycles. The action taken in cycle I and cycle II during mathematics learning on circle equation material is through working on Student Worksheets assisted by GeoGebra software. In the planning stage of the first cycle, various learning tools are prepared which include lesson plan, students worksheet assisted by GeoGebra software, and presentation materials in the form of Powerpoint. Furthermore, researchers also make a grid of questions and quizzes that are used to measure students' learning outcomes on circle equation material. Discussions were also held with subject teachers, to equate perceptions and actions to be taken. All lesson plans are prepared together with the subject teacher. Preparation is optimized so that in carrying out the action there are no different interpretations between the subject teacher and the research team.

At the stage of action of cycle I, researchers provide motivation regarding the usefulness and benefits of circle equation material in everyday life, followed by the delivery of learning objectives to be achieved. In the core learning activity, students are given presentations materials in the form of Powerpoint and asked to listen to a demonstration of drawing circle equations using GeoGebra software conducted by researchers. Then, students are asked to discuss in groups using the worksheets that have been distributed. In the discussion, GeoGebra software is used to assist students in finding the general form of circle equations. Several student representatives are then asked to express their opinions at the end of the

discussion. Furthermore, questions and answers are carried out and learning conclusions are made by students with the teacher.

In the observation stage of cycle I, researchers are assisted by observers who are Mathematics Teachers of SMAN 1 Mengwi. The focus of observation activities carried out is to observe the suitability of learning implementation with the steps that have been prepared in the lesson plan, as well as observing student activities during learning. The implementation of learning using GeoGebra software in the first cycle goes well, students are interested and motivated to follow the learning so that student learning activities takes place quite conducively. The results of observations are then poured into the form of field notes and used as a basis for carrying out reflection activities.

The reflection on the implementation of cycle I aims to find out the progress that has been achieved, the obstacles encountered, and what steps will be taken to maintain and improve the progress that has been achieved and minimise the obstacles experienced during the implementation of the cycle. In general, the implementation of cycle I is in accordance with the plan that has been set. Likewise, in carrying out the actions the teacher has carried out learning in accordance with the preparations that have been prepared in the planning step. Several obstacles are encountered, among others, students are not familiar with using GeoGebra media so that some students look desperate. Teachers have also taken positive steps when they see these obstacles. Students are directed to work in groups even though the results are not optimal. In group discussions it seems to be dominated by students who have abilities above average, consequently students with lower middle abilities do not get the same opportunity to present their opinions when they are discussing.

After carrying out the learning process in cycle I, students are given a test in the form of a quiz to find out the level of mastery of the material. The learning process in cycle I still experiences a few obstacles, such as the discussion time lasts too long so the quiz processing time is shortened from the initial plan. The results of the research in the first cycle are then compared with the success criteria. It can be seen that the classical learning completeness is still below the stipulated conditions. Thus, the research continues to the second cycle.

In the planning stage of cycle II, researchers consider the results of cycle I reflection, then follow up with the distribution of students worksheets the day before learning through Google Classroom. This is done so that students can learn the material in advance, so that learning discussions in cycle II can be in accordance with the initial time planning and run not too long.

Activities in cycle II are carried out well, the learning process is carried out the same as in cycle I. In cycle II students are quite accustomed to using GeoGebra software in learning. This is evident from the percentage of observations of the implementation of learning in cycle II which are in accordance with the steps prepared in the lesson plan. The following is a table of observations of learning implementation.

Table 1. Observations of Learning Implementation

Learning Observation	Percentage of Implementation
Cycle I	90%
Cycle II	100%

One of the success indicators in this study is the implementation of learning using GeoGebra software which is indicated by the percentage of learning observation sheets (Sumandya et al., 2022). Based on data analysis techniques, this indicator will be achieved if at least 80% of the learning stages on the observation sheet are carried out. Based on the data in table 1, it is concluded that learning using GeoGebra software is carried out.

Interviews are conducted at the end of each cycle to determine students' responses to the use of Geogebra software in learning. Some conclusions obtained from cycle I and II interviews are: students' understanding of the material becomes better through the use of GeoGebra software in learning, students' awareness and level of cooperation in group discussions are getting better, and students are more motivated to learn.

The purpose of using GeoGebra software in learning circle equations in this study is to improve student learning outcomes. Student learning test results between cycle I and cycle II have improved. The increase in class average and classical completeness in students who obtain scores within the standard score limit is evidence that there is an increase in student learning outcomes. The following is the data on student learning outcomes.

Table 2. Students Learning Outcomes

Learning Outcomes	Lowest Score	Highest Score	Average Score	Percentage of Students Achieving the Standard Score
Cycle I	25	100	83	75%
Cycle II	45	100	90	89%

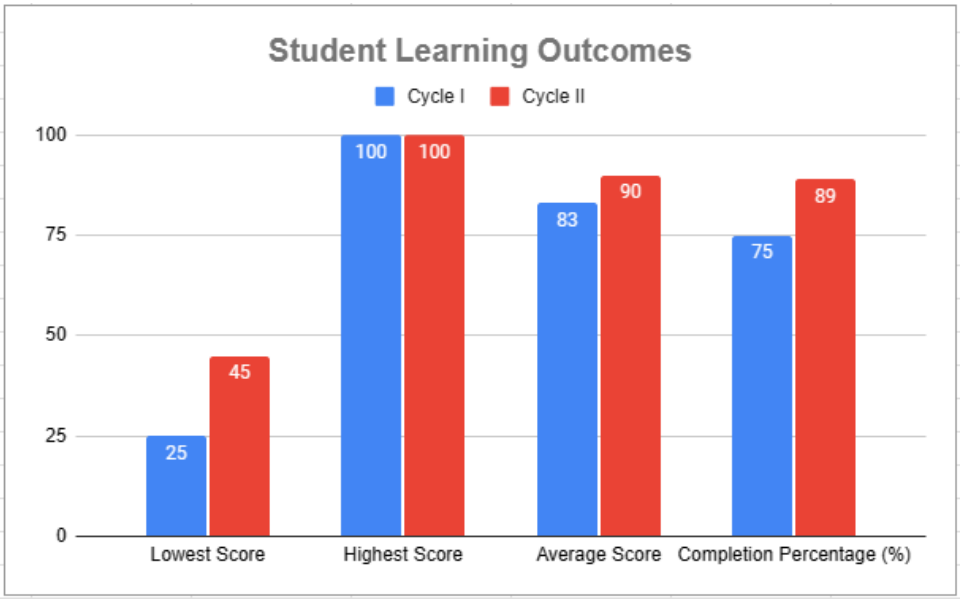

Image 2. Comparison Graph of Student Learning Outcomes in Cycles I and II

Based on the data in the table & graph above, it can be seen that student learning outcomes in the first cycle result in the lowest score which is 25, the highest score which is 100, the average score which is 83 with the percentage of the number of students who achieve the standard score with 75%. In the second cycle, the lowest score is 45, the highest score is 100,

and the average score is 90 with the percentage of students who manage to reach the standard score by 89%. The data above shows that student learning outcomes have improved. This is evidenced by the increase in the average score of students in cycle I that reached 83 and in cycle II by 90. This shows an increase in the average mastery of circular equation material, from cycle I to cycle II which increases by 7. Classical completeness in cycle I is 75% and cycle II is 89%. This shows an increase in classical completeness of mastery of circle equation material, from cycle I to cycle II with the increase by 14%. Because the results of the data in the second cycle have exceeded the indicator, namely the percentage of students who achieve the standard score has been above 75%, this research is said to have been successful and does not need to be continued to the next cycle. Based on these results, it can be concluded that the actions taken in this study, in the form of using GeoGebra software in learning mathematics on circle equation material, have proven successful in improving the learning outcomes of grade XI MIPA5 students of SMAN 1 Mengwi.

CONCLUSION

Based on the results of the study, it can be concluded that the use of GeoGebra software in learning circle equations can improve the learning outcomes of grade XI MIPA5 SMAN 1 Mengwi students in the academic year 2022/2023. The advice that can be given related to the results of this research is by looking at the learning results and enthusiasm of students when using GeoGebra software, it is necessary to continue using GeoGebra software in other Geometry & Algebra materials in the future.

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