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Exploring the Effectiveness of the Learning Cycle Model in Enhancing Mathematics Learning for Students

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ABSTRACT

Purpose of the study: This study aims to determine the effectiveness of implementing the Learning Cycle model in mathematics learning.

Methodology: This type of research is pre-experimental research with The One Group Pretest-Posttest Design. The sampling technique in this study is by Multistage Sampling. The research instruments used are learning outcome tests, student activity observation sheets, and student response questionnaires. The data analysis used is descriptive analysis and inferential analysis..

Main Findings: 25 students or 89.29% achieved individual completeness and 3 students or 10.71% did not achieve individual completeness. This means that classical completeness was achieved with a normalized gain value of 0.70 in the high category. Based on this, the application of the Learning Cycle model is effective in learning mathematics for students.

Novelty/Originality of this study: This study offers a new perspective by showing that the application of the Learning Cycle model significantly improves students' conceptual understanding and mathematical problem-solving skills compared to conventional learning approaches.

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1. INTRODUCTION

Education aims to improve the quality of human beings and to make the nation's life more intelligent [1]. However, in reality, education still experiences unsolved problems and the results achieved have not entirely met expectations [2]. Effective education can be seen from good and satisfying learning outcomes, to obtain these results requires the ability to obtain, select and manage information that involves or requires critical, systematic, logical, creative thinking and a willingness to work effectively [3]-[5]. This way of thinking can be developed by learning mathematics, because mathematics has a strong and clear structure and relationship between its concepts so that students are skilled at thinking rationally [6]-[8].

Mathematics is one of the subjects taught at all levels of education that aims to train students to think logically, rationally, critically, and systematically [9]-[11] and so that students can use mathematics and mathematical thought patterns in everyday life in studying various sciences because mathematics is the queen and servant of other sciences [12], but in reality mathematics is actually a subject that is less popular with most students because most students consider mathematics to be a difficult and boring subject. This causes a lack of interest and activeness in students to receive lessons.

Based on initial observations at State Senior High School 6 Gowa which showed that students were less active in the mathematics learning process, students' mathematics abilities were still low so that they affected student learning outcomes and negative student responses to mathematics learning. In addition, students considered that the material being studied had nothing to do with student experience which resulted in a lack of interest in mathematics learning and students' understanding of concepts that affected student learning outcomes.

In addition, the effectiveness of learning is also caused by the model or method applied by the teacher [13]-[15]. Thus, teachers need to present learning strategies or models that can improve student learning outcomes, student activities and student responses [16]-[18]. There are several types of learning models that can be applied, one of which is applying the Learning Cycle model [19]. The Learning Cycle is a series of stages of activities (phases) that are organized in such a way that students can master the competencies that must be achieved in learning by playing an active role [20],[21]. The Learning Cycle initially consisted of exploration phases, concept introduction, and concept application [22]. The three-phase Learning Cycle has been developed and refined into 5 and 6 phases. Learning Cycle phase 5 is often called LC 5e, while the LC 5e phases are Engagement, Exploration, Explanation, Explanation, Elaboration and Evaluation [23],[24].

Previous research conducted by Risal & Astutik [25] has a gap with the current research, namely: Previous research focused on the application of the Learning Cycle model in the context of Islamic religious education at the junior high school level, with the aim of measuring its effectiveness on student learning outcomes in terms of religious values. The results of this study indicate that the Learning Cycle model can improve students' understanding of religious material. However, the study has not explored the effectiveness of this model in other fields, such as mathematics, which have different material characteristics and ways of thinking. The current study seeks to fill this gap by testing the Learning Cycle model in mathematics learning, observing how the model contributes to students' understanding of mathematical concepts and analytical skills.

This study is novel because it utilizes the Learning Cycle approach in the context of mathematics learning, a field that demands different conceptual understanding and problem-solving skills compared to other fields such as religious education. Although the Learning Cycle model has been successful in improving learning outcomes in various disciplines, its application to mathematics learning has not been studied in depth. The urgency of this study lies in the need to find effective teaching strategies to improve students' understanding and learning outcomes in mathematics, considering that mathematics is often considered a difficult and challenging subject. With the empirical evidence produced, this study is expected to be able to provide significant contributions in enriching mathematics teaching methods, which can be applied at various levels of education.

Based on the background above, the aim of this research is to find out whether the Learning Cycle learning model is effective for use in mathematics learning.

2. RESEARCH METHOD

2.1. Research Design

This type of research is quantitative research. Quantitative research methods can be interpreted as research methods based on the philosophy of Positivism [26],[27], used to research certain populations or samples, sampling techniques are generally carried out randomly, data collection using research instruments, data analysis is quantitative/statistical in nature with the aim of testing the hypothesis to be determined [28]. In this quantitative research, using experimental research methods. Experimental research methods can be interpreted as research methods used to find the effect of certain treatments on others under controlled conditions [29].

2.2. Population and Sample

Population is the entire object to be studied. The population in this study were all students of Class XI of State Senior High School 6 Gowa totaling 201 people and divided into 6 classes where there are 2 majors, namely the science and social studies majors. In both majors, each major is divided into 3 classes, namely XI Science 1, XI Science 2, XI Science 3, XI Social 1, XI Social 2, and XI Social 3. The sample in this study were all students of class XI Science 2 of State Senior High School 6 Gowa totaling 28 people consisting of 11 males and 17 females. The sampling technique in this study was by Multistage Sampling. It is called Multistage Sampling because sampling is carried out sequentially in two levels/stages or more, where we choose a sample using a combination of different sampling methods. With homogeneous population conditions, the first stage in this sampling is by Purposive Sampling. Purposive Sampling can be interpreted as taking samples intentionally with the required sample requirements or specific purposes [30]. Based on the Purposive Sampling, from both the science and social science departments at State Senior High School 6 Gowa, the class from the science department is needed as a sample. This is because the mathematics class in the science department is more than the mathematics class in the social science department and this can make it easier for researchers. Then in the second stage in the sampling technique, namely by using Cluster Random Sampling. This technique is carried out when the population does not consist of individuals, but rather groups of individuals [31], [32].

2.3. Data collection technique

Data collection in this study, namely data on student learning outcomes, was obtained using a learning outcome test given to the experimental class after treatment was given. Data on student activities during treatment were obtained using a student activity observation sheet at the time of the action through observation. Data on student responses to the learning treatment used were obtained using a student response questionnaire distributed after treatment was given.

2.4. Data Analysis Techniques

The data analysis techniques used in this study are descriptive statistical analysis and inferential statistics. Inferential statistical criteria are used to test the research hypothesis using the t-test. However, before testing the hypothesis, a normality test is first carried out.

2.5. Research Procedure

This study used a quantitative method with an experimental approach to test the effect of certain treatments on student learning outcomes under controlled conditions. The study population included all 201 students of grade XI of Gowa 6 State Senior High School. The research sample was selected using the Multistage Sampling technique, which began with Purposive Sampling to determine the science class as a sample, because this class has more mathematics lessons. The second stage used Cluster Random Sampling to select students in the XI IPA 2 class group as the final sample, consisting of 28 students. Data were collected through learning outcome tests to measure improvements in student understanding, observation sheets to record student activities during the treatment, and questionnaires to determine student responses to the learning methods applied. Data analysis involved descriptive statistics to provide an overview, as well as inferential statistics with a normality test followed by a t-test to test the research hypothesis. This procedure aims to understand the effectiveness of the treatment given in improving student learning outcomes in the experimental group.

3. RESULTS AND DISCUSSION

3.1. Descriptive Statistical Analysis

Descriptive statistical analysis is intended to describe the characteristics of the research subjects before and after mathematics learning, student learning outcomes, student activities during the learning process, and student responses to mathematics learning through the application of the Learning Cycle model in class XI of State Senior High School 6 Gowa. The description of each analysis result is described as follows:

3.1.1. Description of Students' Mathematics Learning Outcomes through the Application of the Learning Cycle Model in Class XI of State Senior High School 6 Gowa

If students' mathematics learning outcomes are grouped into 5 categories, the frequency and percentage distributions obtained are as follows:

Table 1. Frequency Distribution and Percentage of Mathematics Learning Outcome Scores After Implementing the Learning Cycle Model

Value	Category	Frequency	Percentage (%)
$0 \leq x \leq 54$	Very Low	2	7.14
$54 \leq x \leq 69$	Low	1	3.57
$69 \leq x \leq 79$	Currently	14	50.00
$79 \leq x \leq 89$	Tall	9	32.14
$89 \leq x \leq 100$	Very high	2	7.14
Amount		28	100

The table above shows that out of 28 students of class XI of State Senior High School 6 Gowa, students who obtained scores in the very low category were 2 students (7.14%), students who obtained scores in the low category were 1 student (3.57%), students who obtained scores in the medium category were 14 students (50.00%), students who obtained scores in the high category were 9 students (32.14%) and students who obtained scores in the very high category were 2 students (7.14%). After the average score of student learning outcomes of 77.21 was converted into the 5 categories above, the average score of mathematics learning outcomes of class XI of State Senior High School 6 Gowa after being taught through the application of the Learning Cycle model was in the medium category.

Furthermore, the learning outcome data after learning through the application of the Learning Cycle model (posttest) is categorized based on the completion criteria which can be seen in the following table:

Table 2. Description of Students' Mathematics Learning Outcomes Completeness after Implementing the Learning Cycle Model

Score	Category	Frequency	Percentage (%)
$0 \leq x \leq 70$	Not Completed	3	10.71
$70 \leq x \leq 100$	Completed	25	82.29
Amount		28	

From the table above, it can be seen that there are 3 students (10.71%) who did not complete the course, while there are 25 students (89.29%) who met the individual completion criteria. If the table above is associated with the indicators of student learning outcome completion, it can be concluded that the mathematics learning outcomes of class XI of State Senior High School 6 Gowa after the Learning Cycle model was implemented have met the classical learning outcome completion indicators.

3.1.2 Description of Improvement in Mathematics Learning Outcomes after Implementing the Learning Cycle Model

Description of Improvement in Mathematics Learning Outcomes after Implementing the Learning Cycle Model:

Table 3. Normalized Gain Level Criteria

N-Gain Value	Criteria
N-gain $\geq$ 0.70	High
0.30 < N-gain < 0.70	Medium
N-gain $\leq$ 0.30	Low

Based on the table above, it can be seen that there are 16 or 57.14% of students whose gain value is ≥ 0.70, which means that the increase in their learning outcomes is in the high category and 12 or 42.86% of students whose gain value is in the interval 0.30 < N-gain < 0.70, which means that the increase in their learning outcomes is in the moderate category.

3.1.3. Description of the Results of Observations of Student Activities in Learning through the Application of the Learning Cycle Model

The criteria for the success of student activities in this study are said to be effective if at least 75% of students are actively involved in the learning process. Based on the results of the analysis of student activity observations during the mathematics learning process through the application of the Learning Cycle model, it can be said that student activities in this study have been effective. This can be seen from the percentage of students who attended the teaching and learning activities during the four meetings as much as 97.32%, the percentage of students who paid attention to the material during the study was 89.29%, the percentage of students who were able to answer questions asked by the teacher about the material being studied was 50.89%, students who asked questions about subject matter that had not been understood during the teaching and learning process were 40.18%, students were able to work together with their group members as much as 90.18%. Students are able to create a concept of material and find alternative solutions to problems with their group mates as many as 90.18%, students who record ideas and opinions during the discussion as many as 90.18%, students are able to explain the concept that has been created with their own sentences and thoughts as many as 68.75% and the percentage of students able to develop understanding of the concept into a different context during four meetings as many as 90.18%, from several activities observed during the four meetings, the average percentage of positive student activities is 78.57% of students who are active in learning mathematics. From the table it can also be seen that from the four meetings observed only 7.14% of students did other activities during the teaching process and 0% of students came in and out without permission.

3.1.4. Description of Student Response Results to Mathematics Learning through the Application of the Learning Cycle Model

Based on the results of the analysis of the student response questionnaire to mathematics learning through the application of the Learning Cycle model, it shows that students who responded very happy were 23.02%, students who responded happy were 73.02%, students who responded unhappy were 3.96% and students who responded very unhappy were 0%. If added up, the average score of students' positive aspect answers, namely students who responded very happy and happy reached 96.04% and the average score of students' negative aspect answers, namely students who answered unhappy and very unhappy reached 3.96%. According to the criteria in Chapter III, student responses are said to be positive if the average student answer to the positive aspect statement is obtained by a percentage reaching 75%. Thus, the application of the Learning Cycle model received a positive response from students.

3.2. Inferential Statistical Analysis

Before carrying out a hypothesis test, a normality test must first be carried out as a prerequisite test..

3.2.1. Normality Test

The normality test aims to determine whether the average score of student learning outcomes (pretest-posttest) is normally distributed. The test criteria are:

If $P_{value} \geq \alpha = 0.05$ then the distribution is normal.

If $P_{value} < \alpha = 0.05$ then the distribution is not normal.

By using the help of a computer program with the Statistical Product and Service Solutions (SPSS) version 19.0 program with the Kolmogorov-Smirnov Test. The results of the average score analysis for the pretest showed a Pvalue> α value of 0.200> 0.05 and the average score for the posttest showed a $P_{value} > \alpha$ value of 0.130> 0.05. This shows that the average pretest and posttest scores are in the normal category.

3.2.2. Hypothesis Testing

The average student learning outcomes after being taught with the Learning Cycle Model were calculated using the one sample t-test formulated with the following hypothesis:

$H_0 = \mu \leq 69.9$ versus $H_1 = \mu > 69.9$

Description: μ = average score of student learning outcomes

Based on the results of the inferential analysis, namely the t-test, the Pvalue = 0.000 was obtained with a significance level of α = 0.05, this indicates that $P_{value} < \alpha$, meaning H_0 is rejected and H_1 is accepted. In other words, the average posttest learning outcome reached 70, namely 77.21.

The students' learning completeness after being taught with the Learning Cycle model is calculated classically using a proportion test formulated with the following hypothesis:

$H_0 = \mu \leq 74.9$ versus $H_1 = \mu > 74.9$

Note: μ = classical learning completeness parameter

Classical student completeness testing is carried out using a proportion test. For the proportion test using a significance level of 5%, $Z_{table} = 1.645$ is obtained, meaning H_0 is accepted if $Z_{count} \leq 1.645$. Because the value of $Z_{count} = 1.667 > Z_{table} = 1.645$ is obtained, then H_0 is rejected, meaning that the proportion of students who achieve the classical completeness criteria (completeness criteria = 70) reaches 75%.

Based on the description above, it can be seen that the proportion of students who achieve the 70 completeness criteria reaches 75%. However, it can still be concluded that inferentially the results of students' mathematics learning after being taught with the Learning Cycle model meet the criteria for effectiveness. This is because the proportion test conducted had a small number of samples so the possibility of rejecting H_0 is very small.

The average normalized gain of students after being taught with the Learning Cycle model was calculated using the one sample t-test which was formulated with the following hypothesis:

H_0: $\mu g \leq 0.30$ versus H_1: $\mu g > 0.30$

Description: μg = average score of normalized gain

Based on the results of the analysis (Appendix D) it appears that by using a significance level of 5%, the value of t 0.95 = 1.703 and tcount = , because tcount = 43.66 µ t 0.95 = 1.703 was obtained, then H_0 was rejected and H1 was accepted, meaning that the average normalized gain in class XI Science students of State Senior High School 6 Gowa exceeded 0.30. From the analysis above, it can be concluded that the average score of student learning outcomes after learning through the Learning Cycle Model has met the effectiveness criteria.

The implications of this study include the potential application of the Learning Cycle model as an effective teaching strategy to improve students' understanding and learning outcomes in mathematics. If proven effective, this approach can be adopted by mathematics teachers as an alternative learning method that is more interactive and student-centered, thus helping students develop analytical skills and conceptual understanding. However, this study also has several limitations. First, the results of the study may be limited to a particular sample or level of education so that its generalization to other contexts needs to be studied further. Second, the effectiveness of the Learning Cycle model may be influenced by external factors, such as the skills and experience of teachers in implementing this model, as well as the level of active participation of students. Therefore, further research is recommended to explore the application of this model in different conditions and identify other variables that may affect the results.

4. CONCLUSION

From the results of descriptive and inferential analysis, the three indicators of effectiveness have been met, so learning is said to be effective. Thus, it can be concluded that the application of the Learning Cycle model is effective in learning mathematics for class XI students of State Senior High School 6 Gowa. For further research, it is recommended to investigate the application of the Learning Cycle model to other mathematics topics and take into account factors such as differences in student abilities in optimizing learning effectiveness.

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