

The Influence of the Double Loop Problem Solving Learning Model on Student Learning Outcomes in the Biodiversity Material of Class X of Muhammadiyah 7 Senior High School Makassar

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ABSTRACT

This study aims to (1) determine the learning outcomes of students on the material of biodiversity of class X SMA Muhammadiyah 7 Makassar taught using the Double Loop Problem Solving learning model (2) determine the effect of the Double Loop Problem Solving learning model on student learning outcomes on the material of Biodiversity of class X SMA Muhammadiyah 7 Makassar. The type of research used in this study is a quasi-experimental with a research design that uses a non-equivalent control group design. The population of this study was all students of class X SMA Muhammadiyah 7 Makassar in the 2022/2023 academic year, totaling 87 students consisting of 3 classes. The sample in this study was 60 students consisting of two classes, namely class X MIPA 1 and class X MIPA 2. The results of the research that has been carried out show that the Double Loop Problem Solving learning model has an effect on students' cognitive learning outcomes on the material of biodiversity in class X SMA Muhammadiyah 7 Makassar. This can be seen from the posttest data showing that in the experimental class the average score was 91.60 and for the control class it was 90.86. So that the learning outcomes of the experimental class that applies the Double Loop Problem Solving learning model increase more than the learning outcomes of the control class by applying the learning model with a conventional approach based on the research, it can be concluded that there is an influence of the Double Loop Problem Solving learning model on students' cognitive learning outcomes on biodiversity material. Based on the results of the hypothesis test using the independent T-test, the value of student learning outcomes is $0.000 < 0.05$.

Keywords: Biodiversity, Double Loop Problem Solving, Learning Outcomes
INTRODUCTION

The learning process is a fundamental part of education as a whole. The success or failure of achieving learning objectives depends on how the learning process takes place in schools. The learning process is a series of activities involving interactions between teachers, students, and the learning environment. For the learning process to run efficiently, teachers must first conduct learning planning. As stated by Yulia (2015), learning planning contains a series of activities that must be carried out to achieve objectives. Therefore, learning planning can serve as a guideline in designing learning according to needs. To achieve learning

objectives, teachers must create a good plan for the learning process, one of which is determining the learning model used in the learning process.

Choosing a learning model is crucial and must be understood by teachers, as each model focuses on a learning design designed to assist students in achieving their learning objectives. The learning model chosen for the learning process is expected to facilitate students' understanding and mastery of the knowledge in a particular subject.

According to Aris (2016), a teacher must be able to play an active role in finding new models in delivering biology lesson material, so that all students can understand the material optimally and not be bored for students in participating in biology lessons. Where teachers are responsible for implementing learning activities in schools, meaning providing guidance and teaching to students. This responsibility is realized in the form of implementing curriculum development, guiding students in learning, developing students' personalities, characters, and physical, analyzing learning difficulties, and assessing students' learning progress.

In the learning process, teachers are also required to create a learning environment that is enjoyable and engaging for students. Ideally, students are encouraged to participate directly in the learning process, thus creating a positive learning experience. A successful learning process requires a design that actively engages students to optimize their abilities. One approach is the use of appropriate learning models to understand and master the concepts of the subject matter, resulting in optimal learning outcomes. because from the start he was not interested in looking at the object.

The problem of low learning outcomes was also found in high schools, specifically at SMA Muhammadiyah 7 Makassar, one of the cases found concerned student learning outcomes in Biology. Based on the results of interviews conducted by researchers with Biology teachers at the school, it showed that student learning outcomes were not optimal. Many students still did not reach the minimum passing

grade (KKM) of 75. It was found that as many as 55% of students obtained a score of 60 on daily tests.

The learning models used are not yet varied. Much of the learning remains conventional and has not yet implemented many learning models. Teachers need to build student independence to manage their mindsets in a focused manner, finding the best way to convey the various concepts taught so that students remember them longer and can apply them. How can teachers open diverse thinking perspectives from all students so they can learn various concepts and relate them to real life? To direct students' mindsets, teachers need learning models that can guide students' thinking patterns, teachers need learning models that can both direct their thinking patterns and create student independence in learning and discovering new knowledge. To overcome this, it is necessary to find alternative learning strategies that are appropriate, so that innovative, creative, effective, and fun are needed to facilitate students' understanding of biology learning. One such learning model is the Double Loop Problem Solving learning model.

According to Manila (2015), the Double Loop Problem Solving learning model is a problem-solving model that emphasizes finding the cause of a problem and finding the right solution to the problem. The Double Loop Problem Solving learning model has a main characteristic, namely learning that is centered on solving problems that will be solved by students in training them to think creatively. The Double Loop Problem Solving learning model asks not to stop at problem solving and the first solution but to continue to look for alternative ways that can provide more effective problem-solving decisions that can be trusted. The Double Loop Problem Solving learning model has the advantage of being able to create a classroom atmosphere that uses scientific values (Pradipta, et al. (2015)

The Double Loop Problem Solving learning model can be applied to biology learning materials, focusing on problem solving. Biodiversity is a suitable material for the Double Loop Problem Solving model because it contains various authentic problems that can be drawn from it. Biodiversity is considered a conceptual topic.

It brings students closer to problems related to everyday life, which will shape their thinking patterns in discovering concepts in the learning material.

Based on research by Ahied & Rosidi, (2020) it shows that there is an increase in problem-solving abilities that occurs because the Double Loop Problem Solving model can make students more active in learning, able to work together well, discuss in groups, and help students relate learning materials to problems in everyday life.

RESEARCH METHODS

The research method used is a quasi-experimental study (Quasi Experiment) which aims to determine the effect of the use of the Double Loop Problem Solving learning model on the learning outcomes of class X students of SMA Muhammadiyah 7 Makassar. According to (Ardayani, 2015) said that Quasi Experiment research or pseudo-experiment is called so because this type of experiment does not meet the requirements such as the experimental method that is said to be scientific following certain regulations. This study uses a pretest given before the treatment and a posttest given after the treatment(Sugiyono, 2020)This research will be conducted at SMA Muhammadiyah 7 Makassar Jl. Rappokalling Raya No. 42, Rappokalling, Tallo District, Makassar City in the odd semester of the 2022/2023 academic year. The population in this study are all students of class X MIPA at SMA Muhammadiyah 7 Makassar. The sampling technique in this study is using a purposive sampling technique, namely a sampling technique by considering certain conditions that may be able to represent the population. Other conditions are considered by looking at students who have reasons that the average learning outcomes of the two sample groups have high scores compared to other sample groups. The research design used is Nonequivalent Control Group Design. This design uses two groups, namely the experimental group and a randomly selected class named the control group. Before being given treatment, both groups were given an initial test in the form of a pretest to determine students' initial knowledge of the concepts that will be worked on later. After being given different

treatments, each group will be given a final test in the form of a posttest using the same questions as the pretest to determine their learning outcomes.

RESEARCH RESULTS AND DISCUSSION

Research result

The data obtained from biology learning outcomes were taken from 60 students at SMA Muhammadiyah 7 Makassar, grade X Odd Semester of the 2022/2023 Academic Year, consisting of grade X Science 1 as the experimental class with 30 students and grade X Science 2 as the control class with 30 students. In the experimental class, the researcher used the Double Loop Problem Solving learning model, while in the control class, the researcher used the conventional method learning model.

This research was conducted from August 15, 2022, to August 24, 2022. The learning process was conducted in class for three meetings in both classes, namely class X IPA 1 as the experimental class and X IPA 2 as the control class. To determine the cognitive learning outcomes of students who applied the Double Loop Problem Solving learning model, the researcher conducted a pretest before giving the treatment and a posttest after giving the treatment. They also provided worksheet assignments to both the experimental and control classes.

The research findings at Muhammadiyah 7 High School in Makassar included data collected from pre-test, post-test, and student worksheets (LKS). Student observation sheets were also created to track student activities during the classroom learning process.

1. Descriptive Statistical Analysis

The different treatments given to the experimental and control classes, the sample classes in this study, can produce different learning outcomes. In the experimental class, the learning process was carried out using the Double Loop Problem Solving learning model, while in the control class, the contextual model was applied. This difference resulted in different scores for the two classes. The following are the pretest and posttest results, summarized in Table 4.1.

**Table 1 Descriptive Analysis of Comparison of Pretest and Posttest
 Results of Experimental Class and Control Class**

Statistics	Pretest		Posttest	
	Control	Experiment	Control	Experiment
Sample size	30	30	30	30
Ideal score	100	100	100	100
Maximum score	90	83	100	100
Minimum score	47	50	80	80
Score range	43	33	20	20
Average score	61.46	66.33	90.86	91.60

(Source: Attachment Data)

Based on table 1 above, it shows that the Pretest and Posttest scores in the control class and the experimental class show that the Score Range statistics of the two tests are very different, namely in the Pretest test the control class obtained 47 and the experimental class 50, while in the Posttest test the control class obtained a score of 20 and the experimental class 20. So that the average score for the Pretest and Posttest of the control class is 61.46 and the experimental class 66.33 and the average Posttest score of the control class is 90.86 and the experimental class 91.60. Looking at the data above, it shows that cognitive learning outcomes on biodiversity material increased after implementing the Double Loop Problem Solving learning model compared to classes that did not use the Double Loop Problem Solving model.

Based on the pretest and posttest data, the experimental and control classes can be categorized into four categories: Very Good, Good, Sufficient, and Poor. The following table 4.2 shows the categories obtained by both classes after taking the test.

**Table 2 Categories of Learning Outcome Intervals for the
 Experimental Class**

And Control Class

Interval	Learning Outcome Categories	Experiment				Control			
		Pretest		Posttttes		Pretest		Posttest	
		F	(%)	F	(%)	F	(%)	F	(%)
93-100	Very good	0	0	16	53.3	0	0	15	50
84-92	Good	0	0	9	30	0	0	9	30
75-83	Enough	6	20	5	16.6	1	3.3	6	20
<75	Not enough	24	80	0	0	29	96.7	0	0
Amount		30	100	30	100	30	100	30	100

(Source: Attachment Data)

Based on the data in table 4.2 above, the Pretest value in the experimental class before being given treatment by applying the Double Loop Problem Solving learning model in the learning process is categorized as having less learning outcomes for 24 students with a percentage value of 80%. While the Posttest value after giving treatment using the Double Loop Problem Solving learning model during the learning process is categorized as good for 20 students with a percentage value of 80%. Meanwhile, for the control class, it was obtained that the Pretest can be categorized as having less learning outcomes for 29 students with a percentage value of 97%. Meanwhile, for the Posttest class in the learning process, it is categorized as having good learning outcomes for 30%.

The two categories found in both classes indicate that in the experimental class, student learning outcomes before the treatment were relatively low. However, after the treatment, which involved implementing the Double Loop Problem Solving model during the learning process, student learning outcomes improved. Meanwhile, in the control class, student learning outcomes did not improve.

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The following is a comparison category diagram of the interval and frequency of learning outcomes for the Pretest and Posttest in the experimental and control classes.

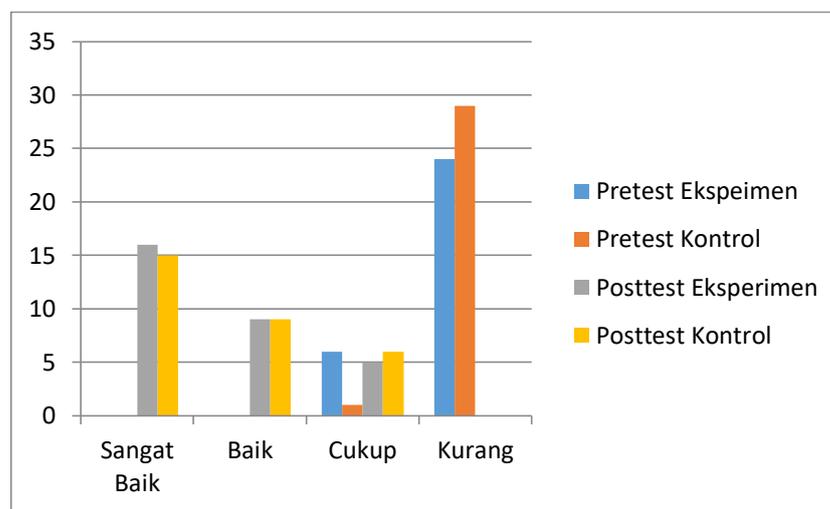


Figure 1 Frequency Distribution and Percentage of Learning Outcome Scores of Students in the Experimental Class and Control Class.

Student learning outcome test data from the experimental and control classes. The experimental class implemented the Double Loop Problem Solving learning model, while the control class implemented the conventional learning model. Table 4.3 shows student learning outcomes based on the maximum completion criteria (KKM).

Table 3 Description of the Learning Outcomes of Students in the Experimental Class and Control Class.

Mark	Category	Experiment	Control
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		Pretest		Posttest		Pretest		Posttest	
		F	(%)	F	(%)	F	(%)	F	(%)
≥ 75	Completed	6	20	30	100	1	3	6	20
< 75	Not finished	24	80	0	0	29	97	24	80
Amount		30	100	30	100	30	100	30	100

(Source: Attachment Data)

Based on table 4.3, the category of student learning outcomes is said to be complete if it obtains a minimum completeness score of 75. If table 4.3 is associated with the indicator of the value of the criteria for completeness of student learning outcomes, the results of the Pretest of the experimental class with a total of 30 students are obtained, 6 students meet the completeness score and 24 students do not meet the specified completeness score. While the Posttest results obtained with the completeness criteria have increased, namely 100%, meaning that the experimental class has achieved the specified completeness score. Meanwhile, for the control class, the acquisition at the time of the Pretest results is known to be complete, namely 1 student completed and as many as 29 students did not complete and in the Posttest results 6 students completed and there are still 24 students who have not completed.

The following will explain in detail the categories and frequencies of student learning outcomes in the experimental and control classes through the diagram below.

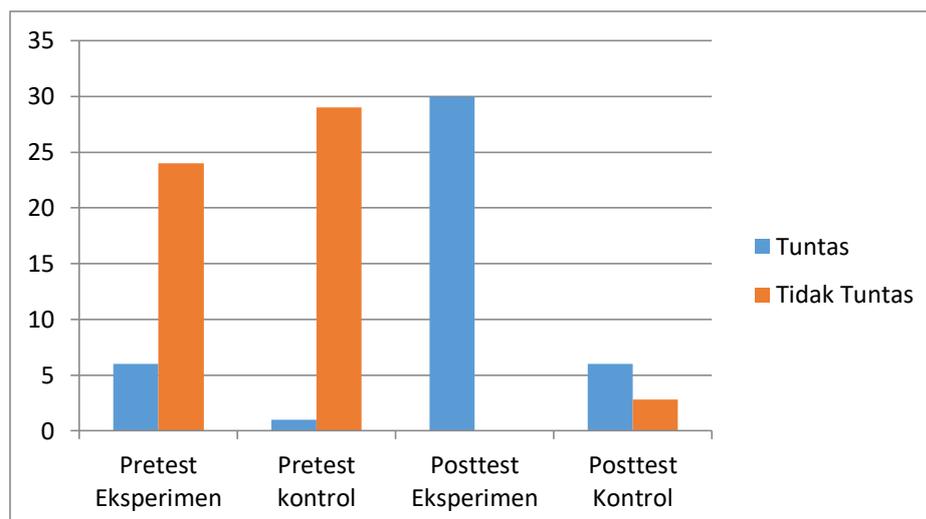


Figure 2. Diagram of Categories and Frequency of Student Learning Outcomes in the Experimental Class and Control Class.

2. Inferential Statistical Analysis

Data analysis using the t-test begins with normality and homogeneity tests, aiming to determine whether the data is normal and homogeneous. Inferential statistical analysis can be explained more clearly as follows:

a. Normality Test.

A normality test was performed to determine whether all variables were normally distributed. The Kolmogorov-Smirnov formula was used for the normality test, and SPSS version 24 was used for calculations. To determine whether the results were normal, a value greater than 0.05 was considered normal; a value less than 0.05 was considered abnormal. The results of the normality test are shown in the table below.

Table 4 Normality Test Results

	Class	Kolmogorov-Smirnov(sig)
Biology learning outcomes	Experimentpretest	0.157
	Experimentposttest	0.200
	Controlpretest	0.167
	Controlposttest	0.176

Conclusion	Sig> α (research data is normally distributed)
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(Source: Attachment Data)

Based on the table above, it is known that the pretest and posttest data on student learning outcomes on biodiversity in biology in both the experimental and control classes have a sig value > 0.05 . Therefore, it can be concluded that both data groups are normally distributed.

b. Homogeneity Test

The homogeneity test used, namely Levene's test, is used to determine whether the data from the research results in the experimental class and the control class have the same variance value. It is said to have the same or no different variance value (homogeneous) if the determined level of significance is approximately >0.05 . If the level of significance is <0.05 , the data is concluded to have no similar or different variance value (inhomogeneous). The results of the calculation using the homogeneity test can be seen in the table below:

Table 5 Results of Homogeneity Test

Statistics	Pretest		Posttest	
	Experimental Class	Control Class	Experimental Class	Control Class
<i>Levene statistic</i>	0.474		0.080	
Sig Level	0.05			
Conclusion	Both Data are Homogeneous		Both Data are Homogeneous	

(Source: Attachment Data)

Based on the table above, the homogeneity test results show that the significance value of Levene's test for the pretest was 0.474 and for the posttest was 0.080. Therefore, the value obtained from the homogeneity test results has a significance level >0.05 , which means it can be said to be the same or homogeneous.

c. Hypothesis Testing

Hypothesis testing was conducted after normality and homogeneity tests. Statistical requirements testing showed that the data were normally distributed and homogeneous from both samples. Therefore, hypothesis testing can be conducted to answer the previously stated hypotheses. This study used SPSS version 24, using the independent t-test. This test was conducted to determine whether there were differences in the posttest results of students from the experimental class and those from the control class. A summary of the hypothesis testing can be seen in the table below.

Table 6 Results of Hypothesis Testing Using the Independent T-test

Test	Learning outcomes
Independent T-test	0,000
Sig level (α)	Sig. < 0.05
Conclusion	H0 is rejected H1 accepted

(Source: Attachment Data)

Based on table 4.6, the results of data analysis using the independent sample t-test. The significance level of 0.05 shows that the sig value is 0.000 < 0.05. So it can be concluded that there are differences in students' cognitive learning outcomes by applying different methods in the two classes. It is known that the learning outcomes of students in the experimental class using the Double Loop Problem Solving learning model are more influential than those in the control class using the conventional learning model. Thus, the test results answer the hypothesis in this study, namely that there is an influence of the Double Loop Problem Solving learning model on cognitive learning outcomes of biodiversity material for class X of SMA Muhammadiyah 7 Makassar.

A. Discussion

This research was conducted at SMA Muhammadiyah 7 Makassar with samples of X IPA 1 (XA) as the experimental class and X IPA 2 (XB) as the control

class. Based on the results of data processing on the research that has been done, it shows that there is a significant difference in students' biology learning outcomes on the concept of biodiversity material using the Double Loop Problem Solving learning model with the biology learning outcomes of students who are taught not using the Double Loop Problem Solving learning model.

Based on the research that has been conducted, data was obtained in the form of cognitive learning outcomes of class X students of SMA Muhammadiyah 7 Makassar. The data was obtained from administering a test in the form of multiple-choice questions to the experimental class which was given treatment in the form of the application of the Double Loop Problem Solving learning model and the control class with the treatment of the application of the conventional learning model. The test was given twice, namely before and after the treatment (pretest and posttest) in the experimental class and the control class.

The difference in student activity between the experimental class and the control class is caused by the use of the Double Loop Problem Solving learning model in the experimental class requiring students to work actively and think more in solving a problem and also discussing to solve the problem so that learning in the experimental class becomes more active. While in the control class, student activity has a percentage below 70% because the use of conventional models that are only monotonous makes students bored to find out for themselves lazy to read a lot so that the problems faced are difficult to solve, it is difficult to work together so that student activity in the class becomes less.

Based on descriptive analysis data on students' cognitive learning outcomes, it is known that before learning in the experimental class and the control class, the average pretest scores obtained by the two classes were not much different, namely in the less category with an average score in the experimental class of 66.33 and the control class 61.46. Then after the treatment was given, the posttest results obtained for the experimental class with the application of the Double Loop Problem Solving learning model had an average score of 91.60 with a good category and the control

class with the conventional model had an average score of 90.86 with a category that was still less. So it can be concluded that the application of the Double Loop Problem Solving learning model can provide a slight influence on high results on biodiversity material in the experimental class.

The implementation of the Double Loop Problem-Solving learning model in the classroom has a positive impact on students' cognitive learning outcomes. This is because students learn independently and actively explore and ask questions about the various aspects of diversity that their teachers don't understand.

According to Isjoni (2012), the learning model is one of the important things in the teaching and learning process to support learning success. The learning process will run well, interesting and can motivate students' interest, among other things, because of the appropriate learning model used. Through learning using the Double Loop Problem Solving learning model, students are stimulated to be more active in finding solutions and solving problems using two different loops and discussing with their group members to solve the problem.

This learning model is said to be influential in the classroom learning process because the Double Loop Problem Solving learning model can shape students with problem-solving abilities. Students will be required to use their existing thinking skills. In learning activities, students will be divided into several groups and then students will be given a problem to solve. Discussion activities using this model will encourage students to identify the causes of the problem, so that students will be able to apply answer strategies to address the given problem. This method will require students to be more active in the learning process and will train students to apply solutions to solve a problem.

And according to (Nizaar & Putra, 2016) the Double Loop Problem Solving learning model is known as a decision-making method that involves the process of considering various alternative solution options which will ultimately arrive at a conclusion that will be used.

Based on the description above, it can be seen that the cognitive learning outcomes of students in the experimental class who were given treatment using the Double Loop Problem Solving learning model were better compared to the learning outcomes of students in the control class who were given treatment using conventional learning methods. This can be seen from the high increase in posttest scores compared to the pretest scores obtained by students. The results obtained are in line with the results of research conducted by (Safitri & Zen, 2018) that the Double Loop Problem Solving learning model requires students to be active in carrying out activities, actively thinking, actively formulating concepts, and giving meaning to something being studied, thereby increasing understanding of the concepts used in problem solving and improving student learning outcomes.

Researchers felt that students' learning outcomes improved using the Double Loop Problem Solving learning model when students could work together and interact more with each other, sharing ideas and opinions in solving a problem through group discussion activities. Researchers implemented discussion activities and provided problems related to everyday life and guided students in solving the problems given, so that students could find solutions to existing problems. This also had an impact on students' affective aspects by discussing, so students could work well together in their groups, and students' curiosity became greater to be able to solve the problem.

Students initially seemed confused by the application of this model, but after it was explained, they appeared more enthusiastic in the discussion activities. They were also freer to think and provide various possibilities to find solutions to solve problems. Not only that, students were also more active in asking and answering questions being discussed. This is because the problems discussed are closely related to their lives, for example problems in the ecosystem that exists in this world. With this, they are more enthusiastic and interested in knowing what the best solution to the problem. This can be seen in the question and answer process, students are more active in asking questions and expressing their opinions. This is

in line with the opinion of Nurjanah, Entang and Mulyati (2015), that the Double Loop Problem Solving learning model is a student-centered learning model, students actively construct their own knowledge. According to Aminah (2016), the Double Loop Problem Solving model has several advantages such as being able to develop thinking skills, problem solving and intellectual skills, students can also work together and respect the opinions of others.

This is supported by the use of student worksheets (LKS) in discussion activities. The use of LKS can increase student interest in learning, especially if the LKS displays an attractive and distinctive appearance. LKS can encourage students to think beyond simply seeing and hearing, but also require students to think critically and creatively to understand concepts and apply them to everyday life (Sasri, Syakbaniah, and Ermaniati, 2015).

The worksheets used in this study are Double Loop Problem Solving model-oriented because they begin with problems related to everyday life, which will shape students' mindsets in discovering learning concepts. These worksheets are structured based on the DLPS learning steps, namely identifying problems, detecting direct causes, evaluating success, analyzing the root cause of the problem, detecting direct causes, and designing root cause solutions (Huda, 2014). Thus, students are more enthusiastic in discussions. Through group discussions, students can develop their skills such as being able to appreciate the opinions of their friends even if they differ from their own, thus developing students' tolerance for the better. This is in line with the opinion of Sumarni, Harun, and Imran (2015), that group discussions can make students more active in thinking and conveying their thoughts through answers to questions that arise, and can be trained in conveying opinions both orally and in writing. According to (Trianto, 2010) discussion activities can also make students aware that by discussing they can solve problems in various ways, and they can exchange opinions constructively so that better decisions can be made and students can get used to listening to other people's opinions even if they differ from their own.

In Loop 1, students in groups discuss the worksheets they've been given. They then devise solutions to the problems they've identified and apply the tentative answers they believe are correct. In Loop 2, if no solution is found, students discuss the problem further and engage in more critical thinking to deduce the problem from the worksheet.

The drawback of this learning model is that it requires a significant amount of time, meaning it requires further study and requires considerable time to fully understand the model's content, the classroom situation, and how students interact when implementing the Double Loop Problem Solving model. Furthermore, not all problems require this model; they may be commonplace and can be solved by students with their group members. As a result, students will become more active and independent in solving problems in class, particularly during assignments and group discussions.

CONCLUSION

Based on the results of research conducted at SMA Muhammadiyah 7 Makassar by the researcher, conclusions can be drawn based on theoretical basis, results of data analysis and processing and looking at the problem formulation described in Chapter I. Therefore, the following conclusions can be drawn from this research:

1. The cognitive learning outcomes of biodiversity material for class X students of SMA Muhammadiyah 7 Makassar who were taught using the Double Loop Problem Solving learning model were known to have an average posttest learning outcome value of 91.60 for the experimental class.
2. There is an influence of the use of the Double Loop Problem Solving learning model on students' cognitive learning outcomes on biodiversity material in class X of SMA Muhammadiyah 7 Makassar. This is based on the results of the hypothesis test that has been carried out using the independent T-test, which obtained a significance level value of $0.000 < 0.05$.

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