



The Effect of the Double Loop Problem Solving Model on Problem Solving Ability and Critical Thinking Skills

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Article Information	ABSTRAK
Submitted: 02 – 11 – 2022 Accepted: 14 – 04 – 2023 Published: 11 – 05 – 2023	Kemampuan pemecahan masalah dan keterampilan berpikir kritis merupakan keterampilan abad 21 yang perlu dikembangkan dengan adanya penerapan model pembelajaran yang inovatif yaitu model <i>double loop problem solving</i> . Penelitian ini bertujuan untuk mengetahui adanya pengaruh model <i>double loop problem solving</i> terhadap kemampuan pemecahan masalah dan keterampilan berpikir kritis siswa. Metode penelitian menggunakan <i>quasi experiment</i> dengan desain penelitian <i>nonequivalent control group design</i> . Teknik pengumpulan data menggunakan <i>pretest</i> dan <i>posttest</i> . Data diolah dengan melakukan uji prasyarat analisis berupa uji normalitas, uji homogenitas sedangkan uji hipotesis yang menggunakan uji <i>one way ANOVA</i> dan uji lanjutan <i>post hoc</i> . Berdasarkan hasil penelitian, dapat disimpulkan bahwa terdapat pengaruh model pembelajaran <i>double loop problem solving</i> terhadap kemampuan pemecahan masalah dan keterampilan berpikir kritis peserta didik pada materi keanekaragaman hayati di kelas X MIPA SMAN 4 Tasikmalaya tahun ajaran 2022/2023 Kata kunci: Keterampilan Berpikir Kritis; Kemampuan Pemecahan Masalah; Model <i>Double Loop Problem Solving</i> .
Publisher	ABSTRACT
Program Studi Pendidikan Biologi, Fakultas Sains dan Teknologi, UIN Walisongo Semarang	<i>Problem solving abilities and critical thinking skills are 21st century skills that need to be developed with efforts to apply innovative learning models, namely double loop problem solving model. This study aims to determine the effect of the double loop problem solving model on students' problem solving abilities and critical thinking skills. The research method uses a quasi experiment with a nonequivalent control group research design. Data collection techniques using pretest and posttest. The data is processed by conducting analysis prerequisite tests in the form of a normality test, homogeneity test while the hypothesis test uses the one way ANOVA and post hoc follow-up tests. Based on the results of the research, it can be concluded that there is an influence of the double loop problem solving learning model on the problem solving abilities and critical thinking skills of students on biodiversity material in class X MIPA SMAN 4 Tasikmalaya in the 2022/2023 academic year</i> Keywords: Critical Thinking Skill; Double Loop Problem Solving Model; Problem Solving Ability.

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INTRODUCTION

21st century skills are needed by students to be successful in facing an upcoming challenge. The current curriculum has accommodated 21st century skills, according to what was said by Redhana (2019) that there are 4 21st century skills that students must have or known as 4C, namely: critical thinking and problem solving (critical thinking and problem solving). problem solving) creativity (creativity), communication (communication) and collaboration (collaboration).

The 2013 curriculum wants learning activities that are more student-centered to create conditions that are active, fun, challenging and contextual (Alwi et al 2019). The creation of an active learning process can be pursued if students are equipped with 21st century skills such as problem solving skills and critical thinking skills so that students are able to process information from various sources and are able to solve various problems. problem solving and critical thinking skills in students.

Problem solving ability is a form of ability that involves thinking processes in solving a problem, so that with the habit of thinking, problems can be achieved and overcome. (Tawil & Liliyasi, 2013). According to Fithriyah et.al (2016) explains that critical thinking skills are the ability of a person to analyze a problem using relevant data, so that a solution to the problem can be found. By thinking critically we can be able to solve problems, evaluate information and make decisions and be able to connect cause and effect in finding solutions to the problems we face. (Alwi et al. 2019).

Problem solving ability is defined as the skill or potential possessed by students in solving problems and applying them in everyday life. Problem solving abilities in students must be trained, for example by involving students in giving assignments and exercises to help students succeed in solving problems and practicing critical thinking skills (Permana et al., 2021).

Students should also strive to have critical thinking skills. Critical thinking skills are skills that emphasize students in explaining what they will think (Sukaisih et al., 2020). Problem solving abilities and critical thinking skills are cognitive abilities possessed by students, and need to be pursued in learning biology. In addition, learning biology does not only emphasize mastery of concepts, but efforts to develop thinking skills and problem solving (Utomo, 2018).

Problem solving abilities and critical thinking skills are cognitive abilities possessed by students, and need to be pursued in learning biology, therefore to develop these abilities and skills in students in learning biology, it needs to be accompanied by efforts to apply innovative learning models and provide opportunities for students to be active in learning. One of the models that can be selected is the double loop problem solving learning model.

The double loop problem solving learning model is a learning model specifically designed in problem solving and is a variation of problem solving learning with an emphasis on finding the main causal (cause) of the problem. (Mas'ad et al., 2018:74). The double loop problem solving learning model is a model of development and variation of problem solving learning. In this model more emphasis on looking for a

causal or cause of a problem. This is in accordance with the statement of Pratama & Suherman (2018) which says that Double loop problem solving is a learning model for the development of Problem Solving learning where the DLPS model focuses more on finding a cause for a problem.

Based on the results of observations made at SMAN 4 Tasikmalaya, problem solving abilities and critical thinking skills in students are still relatively low, this is because students have difficulty and are not used to solving problem solving questions. And during the usual learning activities, there has never been a test of problem-solving abilities and critical thinking skills for students because there are still many students who are not used to answering questions about problem-solving abilities and critical thinking skills. In addition, the lack of varying learning models is one of the causes of problem solving abilities and critical thinking skills are still neglected.

Previous research conducted by (Pratama & Suherman, 2018) explained that the problem solving abilities of students using the double loop problem solving learning model were higher than 4 problem solving abilities of students using the expository learning model. Similar results were put forward by (Yuliana, 2018) explaining that by applying the double loop problem solving learning model in the learning process, students' critical thinking skills are increasing and being well honed.

From the discussion of this background, it can be seen that problem solving abilities and critical thinking skills in students are still low and this study aims to determine the effect of the double loop problem solving learning model on problem solving abilities and critical thinking skills of class X MIPA students of SMAN 4 Tasikmalaya on Biodiversity Material.

METHODE

This type of research is a quasi-experimental study with a non-equivalent control group design. The research started from 15 August 2022 – 02 September 2022 at SMAN 4 Tasikmalaya. The population of this study included class X MIPA students at SMAN 4 Tasikmalaya.

The sampling technique was taken using a purposive sampling technique. The criteria for determining the sample because each group has the same characteristics, such as the same active learning and the average daily test scores are close to each other. The sample used in this study was class X MIPA 5 as the experimental class and X MIPA 4 as the control class. This selection is based on joint consideration of subject teachers so that classes that have the same subject teacher are selected.

Data collection techniques used are pretest and posttest. The aspects that are measured for problem-solving abilities refer to the five indicators of problem-solving abilities developed by Jhonson & Jhonson (Tawil & Liliyasi, 2013), namely defining problems, diagnosing problems, formulating alternative strategies, determining and implementing selected strategies, and conducting evaluations. As for the critical thinking skills instrument, the aspects that are measured for critical thinking skills refer to the five indicators of problem solving abilities developed by Ennis (in Tawil &

Liliasari, 2013), namely providing simple explanations, building basic skills, making inferences, making further explanations and set strategy and tactics.

Learning activities are carried out by applying the syntax of the double loop problem solving learning model, there are various stages which first identify the problem, then identify the cause, after determining the cause of the problem then implementing the initial solution, then identifying deeper causal information by evaluating and analyzing the results of the implementation initial solution so that it finds deficiencies in the initial solution, and finally determines the main solution, at this stage students will find a choice of main solutions that can address the problem in depth down to its roots.

The data obtained from this study included the results of the pretest and posttest in the control class and the experimental class which had been given the item questions, as well as the comparison of the normalized gain (N-gain) between the experimental and control groups. Then the research data is carried out by analyzing the prerequisites test, starting with carrying out the data normality test using the Kolmogorov-Smirnov test and the homogeneity test is carried out by the Levene test. After the results of the analysis prerequisite test stated that the data were normally distributed and homogen, it was followed by testing the hypothesis using the one way ANOVA test and post hoc follow-up tests.

RESULT AND DISCUSSION

Problem Solving Skill

Problem solving abilities are obtained by students after going through learning experiences by being given a problem solving ability test, with the use of the double loop problem solving learning model which has an influence on problem solving abilities. Based on the results of data analysis by testing the hypothesis using one way ANOVA test assisted by IBM SPSS v.24, it was found that the significance value was $0.000 < 0.05$, which means rejecting H_0 and accepting H_a

Problem solving ability is a high level of intellectual activity, students are encouraged and to take initiative and think systematically in dealing with a problem by applying previously acquired knowledge (Somawati, 2018: 40). Students are expected to be able to think systematically in solving problems according to their previous knowledge.

Based on the results of research that has been done in the experimental class where learning uses the double loop problem solving model, and in the control class where learning uses discovery learning. Students' problem-solving abilities were measured using a description test instrument consisting of 10 items consisting of 5 indicators. The five indicators include defining the problem which is divided into 2 questions, diagnosing the problem 2 questions, formulating alternative strategies 2 questions, determining and implementing the chosen strategy 2 questions, and evaluating the success of the strategy 2 questions.

Comparison of the average N-Gain scores for the experimental and control classes can be seen in table 1 below:

Table 1. N-Gain Score Obtained Results

Treatment	N-Gain Score	Category
Experimental Class Problem Solving Ability	0,25	Low
Control class Problem Solving Ability	0,18	Low

Based on the comparison diagram, it can be seen that the average N-Gain score of the experimental class whose learning process uses the double loop problem solving model has an average score of 0.25 in the low category and the average N-Gain score of the control class whose learning process uses the discovery learning model has an average lower than the experimental class, which is equal to 0.18.

The average N-Gain score in the experimental class and in the control class is included in the low category, because the N-Gain score <0.30 is included in the low criteria. The low average N-Gain is due to the lack of learning in the learning process carried out on students in searching for various sources of literature to answer problem solving questions. In accordance with research conducted by Nurafiah (2018) that the learning process in the DLPS model students are required to seek various information from various sources to solve problems because solving problems requires solutions that must be obtained by processing various information.

In the experimental class, the learning process uses the double loop problem solving model, where in the process students are presented with a problem and then students identify the problem. In line with Yuliana's opinion (2018) that the double loop problem solving learning model focuses on identifying the main causes of the emergence of a problem so that students are able to identify the problem correctly. In addition, according to Shoimin (2014) the learning activities carried out in the double loop problem solving model essentially invite students to analyze their thinking in finding a cause of a problem they are facing.

In line with the research of Ahied & Rosidi (2020) that the double loop problem solving learning model focuses on finding the causes of problems which require students to be able to think systematically. Students who are able to detect the cause of a problem will find it easy to get the solution they are facing.

Whereas in the control class the average N-Gain was lower. The low result of the N-Gain score is due to the ongoing learning activities that do not apply discussion techniques that are less than optimal due to various factors either in limited time or the mastery of material content in students has not been obtained properly. In line with the statement of Utami et.al (2020) that in discovery learning it is inefficient if it is used to teach a large number of students, because it takes a long time to help them find theories or solve other problems.

Problem solving abilities in students will further develop if students are often trained. In obtaining better problem-solving abilities, students must be familiar with well-planned assessments.

Critical Thinking Skills

Critical thinking skills in students are essentially able to develop if they continue to be trained, the provision of a double loop problem solving learning model has an influence on critical thinking skills in biodiversity material. Based on the results of data analysis by testing the hypothesis using the one way ANOVA test, it was found that the significance value was $0.000 < 0.05$, which means rejecting H_0 and accepting H_a

Critical thinking skills play an important role in analyzing arguments, problems based on the credibility of information sources, and being able to solve problems logically (Himmatussolihah et al., 2020). Students' critical thinking skills were measured using a description test instrument consisting of 12 items consisting of 5 indicators, namely giving simple explanations which were divided into 3 questions, building basic skills as many as 3 questions, making inferences as many as 2 questions, making further explanations as many as 2 questions, and set the strategy and tactics as much as 2 questions. Comparison of the acquisition of the average N-Gain score for critical thinking skills in the experimental and control classes can be seen in table 2 below:

Table 2. N-Gain Score Obtained Results

Treatment	N-Gain Score	Category
Experimental Class critical thinking skills	0,28	Low
control class critical thinking skills	0,20	Low

Based on the comparison in table 2, it can be seen that the average N-Gain score of critical thinking skills in the experimental class has an average of 0.28 in the low category and the average N-Gain score of critical thinking skills in the control class has an average lower than the experimental class, which is equal to 0.20. The average N-Gain score for critical thinking skills is higher than the control class. This is because it is influenced by the provision of a double loop problem solving model.

In accordance with research conducted by Safitri & Zen (2018) that students are able to produce various ideas and solve problems in detail based on the statements that have been presented. The researcher analyzed that the students were able to understand the material by using critical thinking that was built on basic skills. Then according to Urbach (2021) states that the ability to think critically provides the right direction in thinking, working, and helps in determining the relationship of something to another more accurately.

Whereas in the control class the average N-Gain was lower. The low achievement of students in critical thinking skills certainly has causal factors. One of the causes of the low critical thinking skills of students is the use of inappropriate learning models in the process of learning activities carried out. (Hidayat et.al 2018) besides that, because during learning activities students are not optimal in receiving material delivery due to various factors, both limited time and mastery of material content in students has not been obtained properly. In line with the results of research from Sa'diyah and Dwikurnaningsih (2019) that the low ability of students' critical thinking is caused by the learning model used is not appropriate, so that

student activities in learning activities tend to be passive and also students' critical thinking skills tend to be low.

The Effect of the Double Loop Problem Solving Model on Students' Problem Solving Ability and Critical Thinking Skills

Based on the results of the post hoc test using SPSS version 24, a significance value of problem solving abilities and critical thinking skills was obtained at 0.05, which means that simultaneously, the double loop problem solving learning model influences the problem solving abilities and critical thinking skills of students on biodiversity material.. This influence is due to the provision of a double loop problem solving learning model

This learning model provides opportunities for students to think in solving problems that occur so that problem solving abilities and critical thinking skills in students increase. In accordance with research conducted by Primary (2018) that the double loop problem solving learning model influences and changes students' problem solving abilities, learning outcomes and students' critical thinking skills.

Furthermore, it can be seen the difference in the average score of N-Gain problem solving abilities and critical thinking skills of experimental and control class students which are presented in the diagram below.

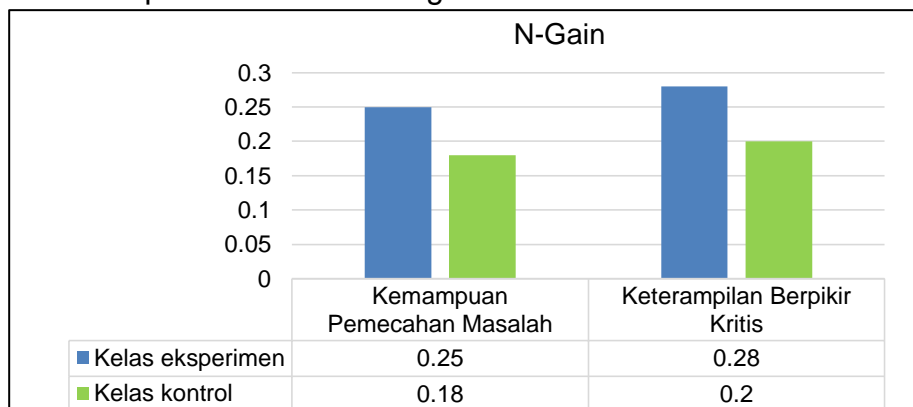


Figure 1. Comparison of N-Gain Scores for Problem Solving Ability and Critical Thinking Skills in Experimental and Control Classes

Based on Figure 1, it can be concluded that there is a difference in the average N-Gain score in problem solving abilities and critical thinking skills in the experimental class whose learning process uses the double loop problem solving model is higher than the control class whose learning process uses the discovery learning model. In line with research conducted by (Silva et.al., 2021) that the application of the double loop problem solving learning model is able to improve problem solving abilities and critical thinking skills in students, because at its stages it always emphasizes finding problems and solving problems so that problem solving abilities problems and critical thinking skills are growing.

Students are required to be more active in learning activities because there are discussions to solve problems. The characteristic of this model is that it works on two loops of the same problem (Permata et.al 2021). In the first loop students are

required to design an initial solution or a temporary solution, and in the second loop students are required to design and implement a definite final solution. This is the characteristic of the model, in contrast to the discovery learning model which is applied in the control class where during the discussion the students involved are less active in learning, because the stages or syntax given are different and not optimal.

The learning process using the double loop problem solving learning model requires students to be able to think actively, so as to stimulate students to develop their problem solving abilities and critical thinking skills. Problem solving abilities and critical thinking skills can be raised in the steps of the double loop problem solving learning model (Sofia, 2018).

According to (Ahied & Rosidi, 2020) learning activities in using the double loop problem solving model in solving problems aim to encourage students to solve problems through two different but interrelated loops. The double loop problem solving learning model has stages in the process, namely identifying problems, detecting causes of problems, implementing temporary solutions, detecting secondary causes and designing final solutions, detecting root causes, and designing final solutions (Jufri, 2015). In the stages of the double loop problem solving learning model, it has interaction and is related to indicators of problem solving abilities and indicators of critical thinking skills (Fatmala et al., 2016)

The double loop problem solving learning model supports the existence of different levels of the cause of a problem, including the mechanism of how a problem occurs. So that in learning students are led to think about a problem more deeply, thus students can understand the material well (Pradipta et al., 2017)

It is known that although the application of the double loop problem solving model in the experimental class has an influence on problem solving abilities and critical thinking skills, the difference in the average score obtained in the control class is not too high, this is because the double loop problem solving model has disadvantages when carrying out the learning process. According to Urbach (2021) said the DLPS model has drawbacks, namely the learning activities carried out require a fairly long time allocation compared to other learning models, and it is difficult to find problems that are appropriate to the level of development. In addition, the limitations in the research encountered during the first study were because researchers were not used to applying the DLPS model, so there were still many shortcomings in applying the double loop problem solving model in class, then because students were more familiar with learning activities carried out using direct and discovery learning models. learning, so that this is the first time doing learning activities using the DLPS model.

CONCLUSION AND RECOMENDATION

Based on the results of data analysis and hypothesis testing, it can be concluded that the double loop problem solving learning model has a simultaneous effect on problem solving abilities and critical thinking skills of students in biodiversity

material in class X MIPA SMAN 4 Tasikmalaya in the 2022/2023 academic year. This can be interpreted that by applying the DLPS model in learning, problem solving abilities and critical thinking skills in students are better and can develop.

For research on the same topic, it is better to deepen the study of the double loop problem solving model by considering material that is in accordance with the characteristics of the double loop problem solving model, then the importance of managing time allocation in the application of the double loop problem solving model so that the learning process can run effectively.

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