



The Effect of Flipped-Problem Based Learning on Curiosity, Creative Thinking and Problem-Solving Ability

Astri Suhartini, Aditya Marianti¹✉

¹Biology Department, FMIPA, Universitas Negeri Semarang, Indonesia

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Abstract

The purpose of this study was to analyze the effect of the Flipped-Problem Based Learning model on curiosity, creative thinking skills and problem solving, and to analyze the relationship between these variables. The study was Pre-Experimental using One Group Posttest Design and One Group Pretest-Posttest Design. The research sample was students of class X-5, X-8 and X-9 at SMA N 3 Salatiga who were selected by purposive sampling. Questionnaires, assessment reports and test instruments are used as data collection tools. The results of this study are students' curiosity in the three experimental classes with high and moderate criteria reaching > 50%. Classical completeness in creative thinking ability reaches > 70% and the n-gain in problem solving ability is in moderate criteria. The relationship between variables has a simultaneous and partial pattern. It can be concluded that the Flipped-Problem Based Learning affects curiosity, creative thinking and problem solving as well as the relationship pattern of the variables are partial and simultaneous patterns.

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✉ Correspondence Address::
D6 Building 1st Floor Jl Raya Sekaran Gunungpati Semarang
E-mail: aditya.marianti.am@mail.unnes.ac.id

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PENDAHULUAN

In the learning process, there are many goals to be achieved by students both cognitive, psychomotor and affective. Problem-solving abilities, creative thinking and student curiosity are important skills that students should have. The existence of curiosity in students will lead to behavior that wants to explore and add information so that it can complete curiosity in students (Raharja, 2018). Creative thinking skills are defined as about applying imagination in dealing with a given problem, thinking systematically in expressing ideas or in solving problems (Sandika, 2018). Then the ability to solve problems is no less important for students. Not only within the scope of learning, problem solving skills are supported by creative thinking skills, so a person will have the ability to be successful in his life because he can solve problems in his life (Susilo, 2012).

Learning after the Covid-19 pandemic has led to new adaptations for students after 2 years of online learning. Dependence on smartphones cannot be avoided by students. Data from PISA and TIMSS show that Indonesia's rating is still very low. From these data, the cause of Indonesia's low ranking is due to the lack of creative thinking problem solving abilities in students. One of the models that developed rapidly during the pandemic was blended learning which combines face-to-face teaching methods with computer-assisted teaching methods both offline and online to form an integrated learning approach (Idris, 2011). Blended learning will be very suitable if applied in distance learning in the pandemic era. Even though the pandemic will end, technological developments will also demand that the learning process not only take place offline but also be combined online, or in other words using the blended learning method.

Flipped-classroom is a form of blended learning method. As research develops, flipped-classroom is combined with the Problem Based Learning (PBL) model and becomes flipped-Problem Based Learning. This model is one of the new breakthroughs in the learning process, because there will be more discussion activities and student-centered learning. This learning model can be an alternative in this pandemic era. Even though learning activities can be carried out offline, this learning model can still be used because it is quite effective and increases students' opportunities for discussion. From the research results, the Problem Based Learning (PBL) model can improve several student abilities, such as problem solving abilities (Nurfiyanti, 2016; Supiandi, 2016), creative thinking skills (Abdurrozak 2016) and students' curiosity (Amalia, 2017). The results of this study are relevant to the title of this thesis, where it is hoped that the use of the flipped-PBL learning model can improve problem solving abilities, creative thinking and students' curiosity.

Environmental change material is one material that can be studied in real terms in the surrounding environment. However, from the results of observations at SMA N 3 Salatiga, the learning process in this material lacks learning by interacting directly with the environment. According to students, the teacher only gave assignments and material to be studied independently and without making observations or direct observations of the surrounding environment. In fact, this material will be more easily understood by students if they directly study in the surrounding environment. In addition, students also tend to be less able to find or find relevant information for this material (Mansur, 2019). Extracting this information is very important because learning outcomes from environmental change material require that students be able to find or formulate ideas so that problems in the environment can be solved. With the application of the Flipped-Problem Based Learning model to environmental change material, it is hoped that students' curiosity, creative thinking skills, and problem solving can increase, and the pattern of influence of these 3 variables can be identified.

RESEARCH METHOD

This research was conducted at SMA N 3 Salatiga in an even semester in the academic year of

2022/2023. The population of this study was all the entire students of grade X SMA N 3 Salatiga consisting of 12 classes that were class X-1 until class X-12. The sampling technique was Purposive Sampling. The sample used was 3 classes, namely class X-5, X-8, and X-9 with the consideration of the students total number was 102 students and teachers who taught the same grade the data in this study include curiosity, creative thinking, problem solving and relationship patterns between variables which are analyzed by descriptive quantitative.

RESULTS AND DISCUSSION

The purpose of this study was to analyze the effectiveness of the Flipped-Problem Based Learning model on environmental change on curiosity, creative thinking and problem solving. The effectiveness of the Flipped-Problem Based Learning model on environmental change material is measured from achievement based on predetermined effectiveness indicators, namely (1) curiosity reaches $\geq 50\%$ of students in the medium and or high categories, (2) creative thinking with mastery $\geq 70\%$ with a minimum mastery criterion (KKM) of 80, (3) problem solving with an n-Gain value in the medium category and classical completeness $\geq 70\%$ with a minimum score of 75.

Student's Curiosity

Class	Curiosity Criteria		
	High	Medium	Low
X-5	20.58%	47.08%	32.53%
X-8	23.53%	35.59%	41.18%
X-9	23.53%	38.24%	38.24%

Table 1. Percentage of Students' Curiosity Criteria

In the data presented in Table 1, it is known that the curiosity of students in the medium and high categories in the three experimental classes is above 50%. In this study, students' curiosity was stimulated by various discussions on environmental change cases in Salatiga. Cases of environmental change that have been widely discussed are the eutrophication case at Lake Rawa Pening, air pollution in Salatiga City and Semarang City and the landfilling of plastic waste at the Ngronggo Landfill in Salatiga.

The learning resources used in this study are teaching materials and online news. The use of online news is based on an increase in students' reading interest in online sessions, where students' reading interest is higher with online news learning resources compared to using teaching materials. In addition, the use of online news can support students in accessing information about various environmental phenomena and can increase their curiosity (Baskoro & Samadi, 2019).

The positive influence on the flipped-problem based learning model, apart from using news in online sessions, offline sessions are also supported by discussions that increase students' curiosity. Student discussions during the research were carried out from the first meeting, namely students were introduced to various cases of environmental change and jointly discussed to identify the causes and effects of these cases to formulate various solutions in subsequent meetings. In each meeting, discussions are always carried out, both on a class scale and on a group scale. This is intended so that students exchange information and students can ask each other about various new things, both to friends and to teachers. The discussion method was chosen with reference to the model used, namely flipped-PBL, where discussion is one of the appropriate methods used in this model. The advantage of the discussion method is to create an interactive

and interesting learning environment that encourages students to ask questions and explore new ideas (Chonstantika & Yamtinah, 2013).

The results of research on the curiosity variable are in line with the results of previous studies. Learning with a flipped classroom will help stimulate student curiosity so that when students are able to work on and solve a problem and the problem is solved by themselves it will create a sense of pride and satisfaction in themselves (Yan et al, 2018; Ramadhani et al, 2020; Putri et al , 2022). This is also in line with Prayogi's research (2021), that learning with the PBL model, especially when using cases in the environment around students, can play a positive role in students' curiosity. Thus, it can be seen that there is a positive effect of using the flipped-PBL model on students' curiosity about environmental change material.

Creative thinking skills

The variable of students' creative thinking ability was measured using an assessment instrument based on student observations. Students' creative thinking ability will be judged on students' ability to provide solutions to cases found. The indicators of creative thinking used in this study are fluency, flexibility, originality, and elaboration (Firdaus, 2018) as well as assessments of student problem analysis.

Of the 4 indicators of creative thinking, the indicators of originality and elaboration are the biggest challenges for students. Indicators of originality or authenticity are assessed from the uniqueness of students' ideas and the development of new innovations from previously existing ideas. While the elaboration or elaboration indicator is assessed from the ability of students to develop and enrich ideas into more detail so that they can be applied according to environmental conditions. These two indicators are the biggest challenge for students when compiling this assignment, especially in innovating new ideas in formulating solutions to problems. The difficulties experienced by these students can be caused by students who are not used to being given assignments that require students to express opinions and are accustomed to working on questions in a closed closed environment (multiple choice).

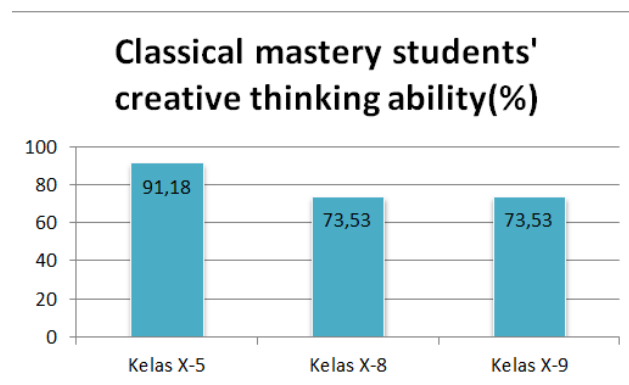


Figure 1. Percentage of classical mastery of students' creative thinking abilities

From Figure 1, it is known that the results of the observation task assessment of the 3 experimental classes show very good results. 3 experimental classes have classical mastery above 70%, even class X-5 reaches 91.18%. Thus, these results are following predetermined standards and it can be concluded that the flipped-problem based learning model has a positive influence on students' creative thinking abilities.

Students' creative thinking abilities are enhanced by discussions held at each meeting, where the discussions discuss various cases of environmental change and students are directed to be able to provide a solution or idea to prevent or handle cases of environmental change. The cases that were discussed were selected based on cases that were close to the students, such as air pollution, accumulation of plastic waste and cases of eutrophication in fresh water waters. The discussions carried out are oriented towards problem solving and students are guided to be able to provide creative ideas for cases that are highlighted during the discussion. By providing stimulus to students and guiding students to carry out investigations through group discussions, students' cognitive abilities will be honed and can spark creative ideas taken from various perspectives.

The data in Figure 1 shows that the research results are in accordance with the hypothesis, that is, there is a positive influence in the application of the flipped-problem based learning model on students' creative thinking abilities. This is in accordance with research from Damayanti et al (2020) which states that learning with flipped-PBL can improve students' creative thinking abilities. Learning with the flipped-PBL model will give students the opportunity to broaden their understanding, especially if they are stimulated by cases that students can find in their environment. Student interaction by conducting an investigation of a case given by the teacher or found by students will help develop various cognitive abilities, one of which is the ability to think creatively (Mardhiyana & Sejati, 2016).

Problem Solving

The problem-solving ability variable is measured by a test instrument, in the form of a multiple-choice test of 20 questions. The questions were given at the beginning before the experimental class was given treatment (pretest) and at the end of the treatment (posttest). From the results of the pretest and posttest were then analyzed descriptively quantitatively by calculating the value of n-Gain, classical completeness and analysis using SPSS. Data on n-Gain values and classical completeness are presented in Table 2 below.

Class	n-Gain	Classical Mastery
X-5	0,498 (<u>sedang</u>)	35,29%
X-8	0,673 (<u>sedang</u>)	91,18%
X-9	0,572 (<u>sedang</u>)	70,59%

Table 2. Student's Problem Solving Analysis Table

In general, the n-Gain results in the three experimental classes showed an increase with the highest n-Gain value in class X-8 and the lowest n-Gain in class X-5. However, the n-Gain values in the three experimental classes were both in the medium category. With an increase in n-Gain, it can be seen that the use of the flipped-PBL model can improve problem-solving skills.

The flipped-PBL model, which is accompanied by a discussion method, requires students to actively seek information and be sensitive about various problems that exist around them. Students' problem analysis skills are honed by the observation assignments given. Then students' abilities in formulating hypotheses, formulating problem-solving and recommending problem-solving are honed during discussions during learning. During the discussion, not only was students' creativity emphasized, but students' abilities in formulating hypotheses and finding recommendations for problem-solving were also the main focus. During the presentation of the discussion results, the student presenter's interaction

with the audience also led to a discussion about the hypothesis of several activities that are often carried out, such as disposing of plastic waste in plantation areas, using pesticides and chemical fertilizers and disposing of livestock waste in Lake Rawa Pening.

Although the n-Gain values in the 3 experimental classes can be categorized as good, the posttest classical completeness results in the 3 experimental classes show different results. The experimental class X-8 and X-9 had good classical mastery, namely $>70\%$, but the experimental class X-5 had a relatively low percentage, namely only 35.29%. The existence of differences regarding students' classical completeness is possible due to several factors, such as lack of motivation to learn, thinking skills, ability to understand problems and low problem-solving abilities of students from the start. This is in accordance with Handayani's research (2017) which suggests that student motivation and students' ability to understand problems is closely related to students' problem-solving abilities.

The existence of a significant difference in the results of the problem-solving ability variable causes the results of the analysis using the normality and homogeneity tests to obtain low scores, which is because the data generated during the study has too varied data so that it is not homogeneous. Thus, the next analysis uses non-parametric analysis, namely the Mann Whitney test and the Wilcoxon test. From the results of the Mann Whitney test, it was found that the three classes had significant differences in terms of the posttest results. This is because the posttest averages in the 3 experimental classes are much different, namely class X-9 has an average of 76.8; class X-8 has an average of 82.1 and class X-5 has the lowest average of 63.9. The cause of differences in posttest results can be caused by several factors such as different percentages of achievement indicators of students being able to formulate problems, namely the presence of student motivation factors and students' ability to understand problems (Handayani, 2017).

From observations during the research, the enthusiasm of students in class X-5 when studying Biology was somewhat less compared to classes X-8 and X-9. The results of interviews with teachers and students in class X-5, the unsatisfactory results of the posttest in this class were because there were 15 athlete students in X-5. From the interviews with the athlete students, their learning motivation was indeed not as big as that of non-athlete students. This is due to several factors, such as their main focus is not on the academic field, but on championships and a series of routine exercises. Due to the tightness of the training activities, many athlete students were tired so they were not optimal in learning the material, which resulted in unsatisfactory posttest scores. This fact is supported by several studies which show that there are indeed differences in the learning outcomes of student athletes and non-athletes (Juwita & Soewarno, 2016) and there is a relationship between fatigue and activity and student academic achievement (Welong et al, 2020).

Meanwhile, the Wilcoxon test showed that there was a significant difference between the pretest and posttest in the three classes. Thus, it can be concluded that the flipped-PBL model can improve students' problem solving abilities. This is also supported by the results of the student response questionnaire, that 94.2% of students agree that problem analysis skills increase, where problem analysis ability is an indicator of problem solving ability. Students' problem-solving abilities can increase with respect to the models and methods used when learning, where students are given a stimulus in the form of realistic environmental change cases for students. Students are also required to always discuss to decide the right and creative solutions for the cases given. Judging from the n-Gain value, the increase in students' problem solving abilities after being given treatment is in accordance with the results of previous studies. This flipped-PBL learning model will provide more flexible time for students to discuss solutions to problems given by the teacher/problems that have been identified by students (Nurfianti, 2016; Supiandi, 2016). By using the PBL model, students will have more opportunities to understand the concepts of problems in their surroundings so that their problem-solving skills can increase (Giri, 2022; Gultom &

Siregar, 2022). However, the existence of an experimental class that had several athlete students caused the classical completeness scores not to fully meet expectations. Thus, this flipped-PBL model has not been able to fully influence students' problem-solving abilities in environmental change material.

The pattern of influence between variables

The data to analyze the influence between variables was taken from data that had been obtained from the instruments used which were then analyzed using SPSS software using multiple regression analysis. The analysis used is to find out how the pattern of influence of variables between variables used in research, either partially or simultaneously.

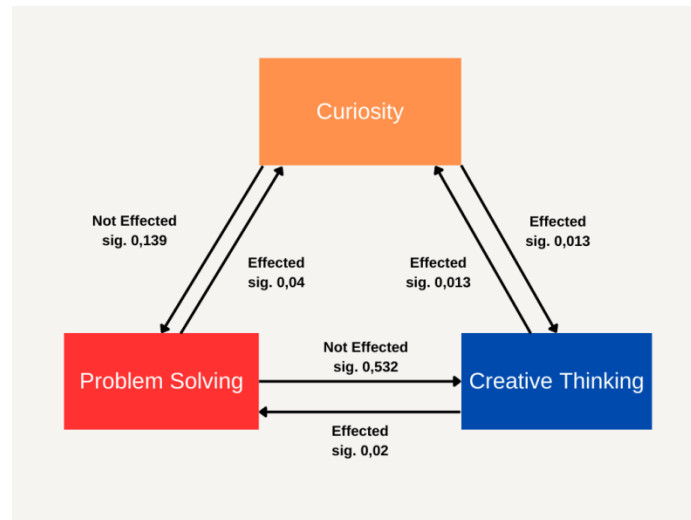


Figure 2. Diagram of the pattern of influence between variables partially

The results of the t-test in Figure 2 above explain that there are different patterns of influence on each variable. Not all variables can affect each other partially because the significance value is more than 0.05. The problem solving variable has no effect on the creative thinking variable and the curiosity variable has no effect on the problem solving variable. While the relationship variables other than the 2 relationships have a significant value of not more than 0.05 so that the hypothesis can be accepted, that is, there is a partial influence of the variable.

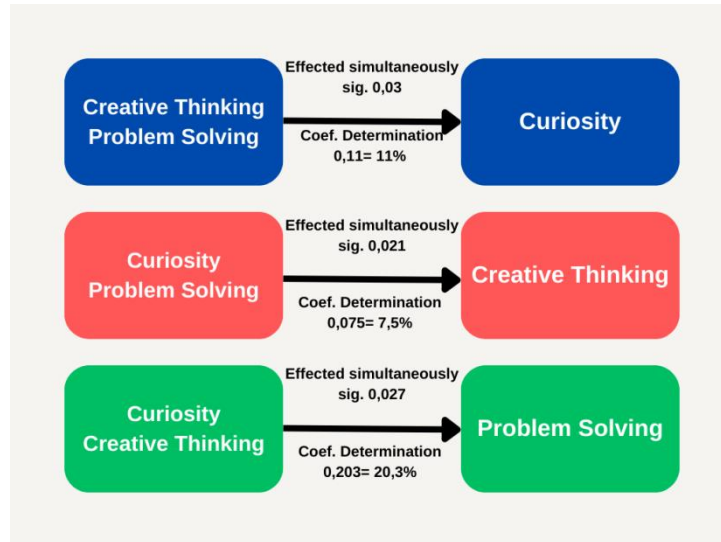


Figure 3. Diagram of pattern of influence between variables simultaneously

In contrast to the results of the t test in the multiple regression analysis which showed that not all variables had a partial effect on the other variables, the F test showed uniform results. From this F test, it was found that all variables simultaneously affect other variables as shown in Figure 3. This is indicated by a significance value of not more than 0.05. The data is also supported by the value of the coefficient of determination, where this data shows how much the variables influence other variables. The biggest coefficient of determination is owned by curiosity and creative thinking variables, which simultaneously influence the problem solving variable by 20.3%. While the lowest coefficient of determination is owned by curiosity and problem solving variables which simultaneously affect creative thinking variables by only 7.5%.

The ability to think creatively and solve problems has a positive impact on students' curiosity in learning biology. Several previous studies have shown that when students are involved in learning processes that require creative problem-solving abilities, students tend to be curious about subject matter and actively seek knowledge and understanding (Hunaepi et al, 2021). Thus, students will be actively involved in seeking knowledge and understanding that can help students to complete their curiosity. By incorporating creative thinking strategies into learning biology, teachers can increase students' curiosity and involvement in the learning process (Hunaepi et al, 2021). In line with the creative thinking variable, the problem solving variable also has an influence on the student's curiosity variable. This is also supported by the results of previous research, where learning with a problem solving approach and problem formulation can encourage curiosity (Evtimova & Trakiiska, 2009).

The ability to solve problems and think creatively requires a broader understanding of concepts and knowledge, so that students can formulate various problem-solving solutions from cases given during research creatively and innovatively. The process of formulating problems based on student discussion will make students exchange information, opinions and various views in deciding the most creative and effective problem solving. Thus, the willingness of students for the information, concepts and knowledge needed will increase which will immediately increase their curiosity. Students' creative thinking abilities and high curiosity will help students to more easily in the problem solving process. High curiosity will lead to more motivation in learning, while creative thinking is categorized as a problem solving process (Nakin, 2003). Thus, high creative thinking skills will bring up various ideas, opinions or ideas to help students design a solution to a given problem, especially if the problem can be found in everyday life. Various solutions can be

designed so that they can have the most effective impact on an existing problem.

The learning process during the research supports the interaction of the 3 variables used. Students are required to know various information and knowledge about the environmental conditions around them. Discovering environmental problems or analyzing activities that can cause environmental changes requires high curiosity about the conditions in the surrounding environment. The pattern of influence of the 3 variables used simultaneously is also supported by the results of the study, that the flipped-PBL model has a positive effect on students' curiosity and creative thinking and can improve students' problem solving abilities.

Student Response

The method used to collect student responses to the flipped-problem based learning model was a questionnaire filled out by 52 students of the experimental class. The questionnaire contains 10 questions to prove how much influence the flipped-problem based learning model has on curiosity, creative thinking skills and problem solving during learning environmental change material.

Student responses to the application of the flipped-problem based learning model on environmental change material are presented in Table 3. The data in Table 3 shows that overall students gave a positive response to the flipped-problem based learning model on environmental change material that had been applied.

No.	Statement	SS&S		TS&STS	
		Resp.	Percentage (%)	Resp.	Percentage (%)
1.	I feel learning Biology using Flipped-Problem Based Learning is more interesting	45	86,5	7	13,5
2.	With the Flipped-Problem Based Learning model, it is easier for me to understand the material on Environmental Change	46	88,5	6	11,5
3.	I am more active in group discussions when learning using the Flipped-Problem Based Learning model	47	90,4	5	9,6
4.	I feel comfortable when learning using the Flipped-Problem Based Learning model	47	90,4	5	9,6
5.	I feel happy learning using the Flipped-Problem Based Learning	44	84,6	8	15,4
6.	I agree that learning using the Flipped-Problem Based Learning model is applied to the next substance	43	82,7	9	17,3
7.	With the Flipped-Problem Based Learning model, I can maximize learning with various media, both books and news from the internet	49	94,2	3	5,8
8.	With the Flipped-Problem Based Learning model on Environmental Change material, I can analyze cases of environmental change in the surrounding area.	49	94,2	3	5,8
9.	With the Flipped-Problem Based Learning model on Environmental Change material, I can arrange solutions that can be done at least by myself.	45	86,5	7	13,5
10.	Flipped-Problem Based Learning model makes my curiosity about environmental change cases increase	46	88,5	6	11,5
Rata-rata			88,65		11,35

Table 3 Summary of questionnaire results of student responses to the application of the flipped-problem based learning model

Based on Table 3 it can be concluded that 88.65% of students agreed and strongly agreed to use the flipped-problem based learning model during class and also stated that the flipped-problem based learning model was also relevant to be applied in any biology material. There were also 11.35% of students who did not agree to use this flipped-problem based learning model in class because it was not attractive to them. This can be related to the psychological aspect that some of these students do not use the open discussion method to learn something new, especially in environmental change material. That is why while in class, the teacher as a facilitator has an important role in managing the class with a particular learning model or method that is applied.

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the flipped-problem based learning model on environmental change material in class X-5, X-8 and X-9 SMA N 3 Salatiga has a positive effect on curiosity and the ability to think creatively. However, it has not had a full effect on students' problem-solving abilities. Patterns of influence between variables of curiosity, creative thinking and problem solving are simultaneous and partial patterns.

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