



Research Article

The Improvement of Learning Motivation and Creative Thinking Skills of Senior High School Students Through Modified Problem Based Learning Model

Audrey Evelyn SAPTENNO¹, Hasan TUAPUTTY², Dominggus RUM AHLATU³, Pamella Mercy PAPILAYA^{4*}

Received: 27 August 2019 **Accepted:** 10 November 2019

Abstract

This research aims at determining the effect of learning models on motivation, creative thinking skills, and cognitive learning results of students of Senior High School 6 of Ambon, Indonesia. This research is quasi-experimental research using a non-equivalent pretest-post-test control group design. The subjects of this research were class XI Science students with a total number of 40 students. One group was taught by using the Modified Problem Based Learning (M-PBL) and the other group was taught by using the discovery learning model. Research data were collected using test and non-test instruments. The data were analyzed by using ANCOVA with a significance level of 5%. The results of the analysis show that the significance value of the learning model towards students' learning motivation and cognitive learning results was $0.000 < 0.05$. The significance value of the learning model towards students' academic skill was $0.000 < 0.05$. The significance value of the learning model towards students' creative thinking skills was $0.030 < 0.05$. The results of this research indicate that the implementation of the M-PBL learning model has an effect on students' learning motivation, creative thinking skills, and learning results better than that of the discovery learning model.

Keywords:

modified problem based learning (M-PBL), learning motivation, creative thinking

To cite this article:

Saptenno, A.E., Tuaputty, H., Rumahlatu, D., & Papilaya, P.M. (2019). The Improvement of Learning Motivation and Creative Thinking Skills of Senior High School Students Through Modified Problem Based Learning Model. *Journal for the Education of Gifted Young Scientists*, 7(4), 1173-1194. DOI: <http://dx.doi.org/10.17478/jegys.597519>

¹ Senior High School 6 of Ambon, Indonesia. Orcid no: 0000-0001-5991-4331.

² Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia. Email: tuaputtyhasan123@gmail.com. Orcid no: 0000-0002-0556-5102.

³ Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia. Email: dominggus_amq@yahoo.co.id. Orcid no: 0000-0002-4466-5528.

⁴ Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia. *Email: joyfullpamela@yahoo.co.id (Corresponding Author). Orcid no: 0000-0003-1055-128X.

Introduction

Biology is one of the branches of science, plays an essential role in human activities, and it continues to develop. Hayat et al. (2017) add that nowadays the development of biological science has reached the field of molecular synthetic biology which is focused on synthetic DNA. Meanwhile, Losos et al. (2013) stated that the 21st century is the golden age of biology, even technology development helped biology grew better. That is why a student should understand biology principles and applied it in their daily life. According to Ball et al. (2016) the 21st-century learning condition should enable a chance for students to practice their skills. Churchill et al. (2013) added that the teacher should design a learning model that based on constructive philosophic to answer and overcome all challenges in this 21st century.

Therefore, biology learning at this time should emphasize on providing students with direct experience to develop their competencies. This is to make the students able to conduct investigations scientifically, logically, and systematically and to understand the natural environment scientifically. Fun biology learning can increase students' learning motivation. The results of the study conducted by PISA (Program for International Assessment) cited by Iswadi (2016) suggest that Indonesia has a high index of science learning motivation as much as 0.65, compared to that of Japan (-0.33) and Singapura 0.59. This depicts how well the Indonesian teachers can create a fun and comfortable biology learning environment for the students. A safe and comfortable learning atmosphere can increase students' motivation.

Learning motivation is a strong desire to achieve satisfaction within an individual to experience the learning process, as well as to obtain excellent learning results and to make better changes (Pradnyana et al., 2013; Widyoko, 2012). Good learning motivation can have an effect on students' learning results and creative thinking skills. The research results by Darmawati (2013) showed that learning motivation had a significant effect on the learning achievement of senior high school students in Tuban. Mustami and Safitri (2018) stated that learning motivation playing the main important role in determining student learning result because motivation is the key process to predict intensity, pathway, and effort to achieve students' objectives.

This indicates that learning motivation plays a key role in learning. In addition, the rapid development of biology learning also requires students to have creative thinking skills. Creative learning is defined as the students' ability to innovate in learning such as developing the knowledge obtained from their teachers so that they can create new combinations in learning (Azizi et al., 2014). Research results by Safitri et al. (2014) show that students' creative thinking skills have a correlation with students' learning results. Kacan and Sahin (2018) added that creativity in science learning is quite important and also integrated with the curriculum, teacher

and the approach that being used by teachers along with the learning process because creativity is human development aspect.

In addition to learning motivation and creative thinking skills, students' academic ability can also have an effect on students' cognitive learning results. Nowadays, classroom learning has not maximally empowered students' potential and academic abilities. Different academic abilities of the students in the classroom have not been noticed by the teacher. The learning models implemented in the classrooms have not been able to entirely empower students' academic ability, so that there is a gap between higher and lower academic ability students. Rahardjanto et al. (2019) asserted that creative thinking skill could guide a student to do some modification or even emerging new ideas. Daud et al. (2011) creative thinking skill is individual ability to use their mind to emerge new ideas, analogy and new discoveries that original and in form of real state or abstract, this kind of ability could be upgraded and developed well. Kind and Kind (2007) added that creativity and rationality always related one another, scientific creativity will never succeed without rationality, experiments and proof. Meanwhile, Ozyaprak (2016) argues that the categories of creative thinking include lateral thinking, problem-solving, productive thinking, brainstorming, and metaphors.

Based on the results of an observation, Senior High School 6 of Ambon has used the 2013 curriculum, but the learning models applied by teachers in learning have not met the demands of the 2013 curriculum. In addition, the learning environment did not maximally empower students' motivation which results in poor learning results and creative thinking skills. A solution which can be used to overcome the problems in class XI of Senior High School 6 of Ambon was by implementing a modified learning model. This modified learning model is the integration of the syntax of the Problem Based Learning (PBL) model with role-playing. The research by Burgess et al. (2018) suggested that learning model modification could be done by a hybrid approach that utilizes the surplus of the PBL and TBL learning model then make all phases of hybrid learning that shows both learning model phases. Tisonova et al. (2009) also show that the modification of the PBL learning model by integrating the proof-based method will produce a better result in student learning result if we compare to conventional PBL learning.

PBL learning model uses real problems encountered in the environment as a basis for acquiring knowledge and concepts through creative thinking skills and problem solving (Wang et al., 2016; Fakhriyah, 2014). A research conducted by Sihaloho et al. (2017) shows that the PBL learning model could increase student critical thinking by the PBL investigation-based syntax. While by Joma et al. (2016) added that learning that using role-playing technique is one way to change the learning condition in this 21st century and enable a student to increase learning motivation. Gusmaweti (2013) states that role-playing is a play/drama that provides a pleasant experience so that it can improve students' understanding.

Research Problem

Based on those proofs, therefore the problem based learning (PBL) learning model could be integrated into role-playing learning model. The integration of the two learning models produces a new learning syntax and referred to as the M-PBL learning model (Modified Problem Based Learning). That is why we need to conduct research to investigate about (1) the influence of M-PBL towards students' learning motivation, and also (2) the influence of M-PBL towards students' creative thinking.

Method

Research Design

This research is quasi-experimental research which aims at investigating the effectiveness of M-PBL and discovery learning models on students' learning motivation, creative thinking skills, and biology cognitive learning results. The design of this research was the pretest-posttest nonequivalent control group design (Table 1).

Table 1.

Research Design of Pretest-Posttest Nonequivalent Control Group Design

Groups	Pretest	Learning strategies	Posttest
Discovery learning model (control)	O ₁	XI ₁	O ₂
M-PBL learning model	O ₃	XI ₂	O ₄

Description:

O₁ and O₃ : Pretest

O₂ and O₄ : Post-test

X₁ : Discovery learning model

X₂ : M-PBL learning model

Research Sample

The population on this research are all students grade XI Science of Senior High School 6 of Ambon. The samples of this research were all the students of class XI₁ dan XI₂ Science in the even semester of the 2017/2018 academic year. The total research sample was 40 students. They were divided into two groups, in which each group consisted of 20 students.

Instruments

Instruments that being used in this kind of learning process including syllabus, lesson plan, student worksheet, essay test item and creative thinking questioner and student learning motivation questioner. Creative thinking questioner using Likert scale with using scores such as very frequently (5), frequently (4), sometimes (3), rarely (2), never (1) on positive statements, while on negative statements using scores such as very frequently (1), frequently (2), sometimes (3), rarely (4), never (5) on positive statements. Students' learning motivation questioner also using Likert scale with scores such as very disagree (1), disagree (2), hesitate (3), agree (4), very agree (5) for positive statements, while very disagree (5), disagree (4), hesitate (3), agree (2), very agree (1) for negative statement.

Research Process

The samples of this research consisted of class XI₁ and XI₂. The learning material taught was about the human circulatory system. The control group was taught by using discovery learning by the biology teacher of the class without any intervention from the researchers. However, the experimental class was taught by using the M-PBL learning model by the researchers. The phases of M-PBL learning are students' orientation on problems, role-playing, guiding students individually or in group, doing an observation, play role-playing again, and evaluation. A pretest and a post-test were carried out before and after the research process. During the learning process, the students were asked to fill out a questionnaire of motivation and creative thinking.

Data Analysis

The data were analyzed by using ANCOVA and then continued with posthoc LSD (Least Significant Different). The pretest, metacognitive skills, concept gaining, and the post-test were used as the co-variance. Before the ANCOVA was performed, the normality and the homogeneity of the data were tested. The normality test was carried out using the Kolmogorov-Smirnov test, while the homogeneity test was done by using Levene's test. The data being analyzed using software SPSS 23.0 for Windows.

Results

Data obtained from the learning motivation skill test, creative thinking and cognitive learning result should be first analyzed using normality assay using one-sample Kolmogorov, Smirnov test and homogeneity assay using Levene's test to find the invalid variance similarity (Table 2).

Table 2.

Prerequisite Test (Data Normality and Homogeneity)

Prerequisite assay	Variables in assay	Sig.
Normality Data	Motivation	.916
	Creative Thinking	.200
	Post-test	.555
Homogeneity Data	Motivation	.078
	Creative Thinking	.208
	Post-test	.365

Table 2 shows that data has a normal distribution and data group has homogeneous variance. Based on this prerequisite assay, creative thinking data, learning motivation and students' cognitive learning result should be analyzed with advance assay using ANCOVA (Table 3).

Table 3.

The Effect of Learning Model on Student Learning Motivation

Source	Number of squares	df	Average squares	F	Sig.
Corrected Model	502.964	2	251.482	59.628	0.000
Intercept	76.442	1	76.442	18.125	0.000
Initial motivation	325.863	1	325.863	77.265	0.000
Learning model	219.932	1	219.932	52.148	0.000
Error	156.047	37	4.217		
Total	240779.861	40			
Corrected Total	659.01	39			

The results of ANCOVA analysis (Table 3) show that in the learning model variable, the F count was 52.148 with a significance value of 0.000 ($0.000 < \alpha < 0.05$). Thus, the research hypothesis stating that the learning model has an effect on student learning motivation was accepted. Next, to determine the significant differences between M-PBL learning model and Discovery in increasing students' learning motivation, therefore the next advance analysis or assay that should be done is posthoc analysis using LSD assay (Table 4).

Table 4.

LSD Test for Student Learning Motivation

Learning model	Notation
M-PBL	a
Discovery	b

The results of posthoc LSD test indicate that the M-PBL and Discovery learning models have different notations (Table 4). This shows that the M-PBL and Discovery learning models have different effects on student learning motivation. On the other hand, the ANCOVA analysis result on the influence of the learning model towards creative thinking skills shown in Table 5.

Table 5.

The Effect of Learning Models on Creative Thinking

Source	Number of squares	df	Average squares	F	Sig.
Corrected Model	153.229	2	76.615	2.982	0.063
Intercept	2352.688	1	2352.688	91.566	0.000
Initial creative	0.419	1	0.419	0.016	0.899
Learning model	130.99	1	130.99	5.098	0.030
Error	950.674	37	25.694		
Total	239478.788	40			
Corrected Total	1103.903	39			

The results of the ANCOVA analysis (Table 5) show that in the learning model variable, the F count was 5.098 with a significance value 0.030 ($0.030 < \alpha 0.05$). Thus, the research hypothesis stating that the learning model has an effect on student creative thinking skills was accepted. Next, to determine the significant differences between M-PBL learning model and Discovery in increasing creative thinking skill, therefore we should conduct the next analysis that is posthoc analysis using LSD assay (Table 6).

Table 6.

LSD Test on Creative Thinking

Learning model	Notation
M-PBL	a
Discovery	b

The results of post hoc LSD indicate that the M-PBL and the discovery learning models have different notations (Table 6). This shows that M-PBL and discovery learning models have significantly different effects on creative thinking skills. The average score of the student's creative thinking skill in the M-PBL class was higher than that of the students in the discovery learning model class (Table 6). This proves that the class XI Science students of Senior High School 6 Ambon are more creative in thinking to understand the concepts of the circulation system using the M-PBL learning model. On the other hand, the ANCOVA analysis result on learning model influence towards students' cognitive learning results shown in Table 7.

Table 7.

The Effect of Learning Models on Cognitive Learning Results

Source	Number of squares	df	Average squares	F	Sig.
Corrected Model	2287.058	4	571.764	25.099	0.000
Intercept	12674.527	1	12674.527	556.376	0.000
Initial tes	5.183	1	5.183	.228	0.636
Learning model	1721.965	1	1721.965	75.589	0.000
Error	797.317	35	22.780		
Total	239475.000	40			
Corrected Total	3084.375	39			

The results of the ANCOVA analysis (Table 7) show that in the learning model variable, the F count was 75.589 with a significance value of 0.000 ($0.000 < \alpha 0.05$). Thus, the research hypothesis stating that learning models have an effect on students' cognitive learning results was accepted. Next, to determine the significant differences between M-PBL learning model and Discovery in increasing cognitive learning result, so the next analysis is posthoc analysis using LSD assay (Table 8).

Table 8.
LSD Test on Students' Cognitive Learning Outcomes

Learning model	Notation
M-PBL	a
Discovery	b

Discussion and Conclusion

The results of ANCOVA analysis (Table 3) show the existence of the influence of the learning model on learning motivation. This means that the implementation of M-PBL learning model could provide a different learning atmosphere for students. This can overcome students' boredom of the usual teaching and learning process. The research conducted by Rizqi et al. (2014) showed that the implementation of the PBL learning model and scientific approaches did not have an effect on student learning motivation. Therefore, the researchers suggested that teachers use variations in implementing PBL models. Sanjaya (2006) mentioned that the weaknesses of the PBL learning model, one of which is that student is lacking motivation to try when the problems faced were difficult ones. Therefore, the integration between PBL learning models and other constructive learning models is necessary (Karmana, 2011). This research integrates the stages of PBL learning model with the stages of role-playing learning model. The results of this integration are called the M-PBL learning model. Therefore, the stages of the M-PBL learning model are different from those of PBL learning model. One of the stage in the syntax of the M-PBL learning model is role-playing. The role-playing can trigger students' attention to act as organs and mechanisms in the concept of the circulatory system. Arif (2016) explains that motivation includes four components, namely attention, relevance, confidence, and satisfaction. Aydogan et al (2017) add that the motivation that includes the impulse of curiosity, desire to learn, and the desire to grow is referred to as internal motivation. When the process M-PBL learning has triggered students' attention to play a role, the students' curiosity will grow, so that they can connect the concept they learn with the role the students play. The next is that the students feel confident to do role-playing, so that they will feel satisfaction upon completing the role play. Since the syntax of M-PBL learning model is able to motivate the students, it has a huge effect on the students filling out the motivation questionnaires. Through role-playing, the students act as if they were the organs and mechanisms of the circulatory system. Thus, it makes the students feel interested and excited.

Other than that, the results of the post hoc LSD test (Table 4) indicate that the M-PBL and Discovery learning models have different effects on student learning motivation. The average score of the student learning motivation in the M-PBL class was higher than that of the students in the discovery learning model class (Table 4). This proves that the students of class XI Science of Senior High School 6 of Ambon are more motivated to learn the concept of the circulatory system using the

M-PBL learning model. Some educational researches investigating the implementation of discovery learning model also indicate an increase in student learning motivation. Hadiono and Hadiyati (2016) report that the discovery learning model increases the learning motivation of class VIII students of Junior High School 2 of Kamal on the learning material about Light. Rizqi (2014) also reported that the discovery learning model increased the learning motivation of Class IV Elementary School Students on the learning material on My Healthy and Nutritious Food. The results of those researches show that the discovery learning model is also able to increase student learning motivation. In this research, however, the learning motivation of the students taught by using the M-PBL learning model increased higher than that of the students taught by using the discovery Learning model. The task of a teacher is to try to create a suitable learning model to improve student learning motivation. In addition, student motivation is also determined by various factors, not only the learning model factor implemented by the teachers in the learning process. The research by Wahyuni et al. (2012) showed that the factors affecting the student learning motivation are students' perceptions of variations in teacher teaching styles, and student learning discipline. The teacher teaching style will certainly be influenced by the learning model used by the teacher. Student learning motivation is measured by the way students respond or answer the questionnaires distributed by teachers. Through questionnaires, students can determine their attitude, whether it is strongly agreed, agree, disagree or strongly disagree with their own learning experience. This means that the perception of the Class XI Science students in Senior High school 6 of Ambon taught by using M-PBL learning model is better.

The results of the ANCOVA analysis (Table 5) show that the learning model has an effect on student creative thinking skill. Teachers have a significant role in selecting an effective learning model to foster students' creative thinking. M-PBL learning model is a learning model that is able to develop students' creative thinking skills. The syntax of the M-PBL learning model trains students' creative thinking. Each stage of M-PBL learning is able to improve students' creative thinking skills, compared to that of the Discovery learning model. Najib et al. (2015) stated that the PBL learning model has characteristics that could enable students' to develop their creative thinking skills because learning begins with students' daily life problems. Through the stage of orientation to the problems, students are encouraged to develop their ideas and to find information to solve the problems they face. This activity will indirectly improve students' creative thinking skills. Daramola et al. (2019) added that students' creativity shown by the ability to understand with new way, making relations between phenomenons, then producing solutions, therefore, creativity involving two thinking process then producing actions.

Moreover, the syntax of M-PBL learning is role-playing, group work, making observations of repeating role play to solve problems. At this stage, the students' constructivist mechanisms are carried out together in groups. M-PBL learning model is one of the learning models based on the constructive learning theory. Through role-playing, students have the opportunity to appreciate the role they are playing. Through observation activity, the students can assess the role played by their friends, and through repeating the role play one more time, the students can have reflection activities to perform the role play better. The same result also published by Kaeser et al. (2004) that active student in PBL learning modification saving information in a much way longer time compare to the conventional PBL learning. Students are social beings, so that with creative and flexible thinking, they will be able to work well in groups to solve problems through role-playing and observation activities.

Other than that, the results of the post hoc LSD test (Table 6) indicate that the M-PBL and Discovery learning models have different effects on creative thinking skills. The average score of the student's creative thinking skill in the M-PBL class was higher than that of the students in the Discovery learning model class (Table 6). This proves that the class XI Science students of Senior High School 6 Ambon are more creative in thinking to understand the concepts of the circulation system using the M-PBL learning model. Several research results show that the PBL learning model is able to improve students' creative thinking skills better than other learning models. Nurcholis et al. (2013) reported that PBL learning models accompanied by scientific articles can improve the creative thinking skills of class X students of Senior High School 2 of Boyolali. The research conducted by Awang and Ramly (2008); Bahri and Corebima (2015) found that the PBL learning model could improve students' creative thinking skills.

The results of the ANCOVA analysis (Table 7) show that learning models have an effect on students' cognitive learning results. The selection of appropriate learning models can improve students' cognitive learning results. Susanto (2012) explains that the selection of appropriate learning models aims to create effective learning, in order that optimal interactions between teachers and students can occur, resulting in better learning results. In this research, the experimental class was taught by using M-PBL learning model while the control class was taught by using the discovery learning model. Table 8 shows the difference in notations between the two learning models toward the students' cognitive learning results. This suggests that the M-PBL learning model improves the cognitive learning results of class XI Science students of Senior High School 6 of Ambon better than the discovery learning model does. Several research results on other M-PBL learning models have shown similar results. For example, Hinderasti et al. (2014) reported that PBL learning model integrated with experimental methods accompanied by roundhouse diagram techniques and mind maps can improve the biology learning results of class

XI students on the concept of the excretion system. The syntax of the M-PBL learning model directs a real learning experience for students so that they can experience meaningful learning which can improve students' cognitive learning results. Aziz et al. (2014) report that the initial stage of the syntax of the PBL learning model is extremely essential, which is organizing students to learn and conduct experiments. In addition, the students are faced with the orientation syntax on the problem through the guidance and direction of the teacher. Najib et al. (2015) explain that the syntax of the PBL model which presents real problems can increase students' knowledge and understanding, which has a positive effect on students' learning results. The modification of the syntax of the M-PBL learning model, which is role-playing, can affect the students' cognitive structure. The students' cognitive structure formed during the learning process of M-PBL is inseparable from the constructivist learning theory. PBL is a cognitive-based learning which is oriented to constructivist learning theory (Koh et al., 2014; Nafiah, 2014). Constructivist learning theory explains that during learning, if students are able to organize and construct their own knowledge, it will be more likely stored in students' memory for a longer period (Budiningsih, 2005). Constructive learning has an idea that the student build a new understanding using the previous understanding, a student could be a more active learning process, also change students' way of thinking so that student could think logically and conceptually.

The series of problem solving processes in the M-PBL learning model has a better effect on students' cognitive learning results compared to the discovery learning model. Furthermore, Akinoglu and Tandongan (2007) explain that the PBL learning model provides the students with a new experience to acquire new knowledge provided that the students do the problem solving processes. The research conducted by Hasanah et al. (2017) which compared the learning results of the students taught by using PBL and discovery learning models showed that the learning results of the class taught by using PBL learning model were 54.718%; while the learning results of the class taught by using the discovery learning model were 53.814%. The discovery learning model is also based on discovery and problem solving. However, in this learning method, the teacher plays more roles and is more creative in directing the students to solve problems, and creating situations that make students actively construct their own knowledge (Hadiono & Hadiyati, 2016). Pranoto et al. (2017) add that the PBL learning model gives more opportunities to the students to actively and independently complete tasks and assignments during the learning process compared to the discovery learning model in class X Senior High School 1 Ngawi. Based on these explanations, the researchers found two factors affecting the results of learning, namely external factors including the teachers' creativity in selecting and designing the learning process, and the internal factors including students' learning styles. This is what causes the students learning by using the discovery learning model to have lower cognitive learning

results than those learning by using the M-PBL learning model. Students' learning style means the most preferred way of learning that the students use. It could be visual, auditory, and kinesthetic learning styles (DePorter, 2007; Pashler et al., 2008). The research conducted by Hinderasti et al. (2014) revealed that the learning results of the students using kinesthetic learning styles were higher than those learning by using a visual learning style. This is because the models, methods and learning techniques require the students to move more actively. The weakness of the discovery learning model in this research was that the teacher did not integrate the syntax of the discovery learning model with the learning methods or techniques which encourage the students to construct their cognition.

The final stage of M-PBL learning in this research was evaluation and brainstorming. The evaluation stage was a stage of reflection on the M-PBL learning process that had been carried out, while the brainstorming stage was the stage of brainstorming between students and teachers to correct weaknesses during the learning process. Furthermore, Supiandi and Julung (2016); Valle et al. (1999) state that the evaluation stage in the PBL learning can be used as reflection activities, which is to rewrite new experiences and knowledge, so that these activities have a positive effect on students' memory, thus influencing students' cognitive learning results. Whereas the evaluation stage for reflection and brainstorming processes are not found in the learning process of the discovery learning model.

The syntax of the M-PBL learning model has been modified to provide students with different learning experiences and atmospheres. The modification of the syntax of the PBL learning model gives an advantage for this M-PBL learning model. The modification of the syntax of the PBL learning model also overcomes the weaknesses of the PBL learning model. However, the implementation of the discovery learning model was without any modification or integration with other learning models, methods, or techniques. Malahayati (2016) reveals that the PBL learning model has strengths and weaknesses that need to be combined with other learning models or other strategies to improve the quality of learning. In addition, the effectiveness of the learning model is supported by two factors, namely the external and internal factors. External factors in learning are learning models, methods, or techniques implemented by the teachers, while the internal factors in learning include students' learning styles and students' learning interests (Hinderasti et al., 2014; Baylor & Ritchie, 2002). Although the teacher has implemented a creative learning model but not supported with sufficient students' learning interests and abilities, the learning is still considered unsuccessful. In addition, when the learning model implemented by the teacher does not accommodate most of the students' learning styles, the effectiveness of learning is not optimally achieved yet.

The results showed a significant difference in the results of motivation, creative thinking and cognitive learning outcomes between students who were taught using

the M-PBL learning model and the conventional learning model. The learning model has an effect on student motivation shown by a significant value ($0.000 < 0.05$), the learning model has an effect on students' creative thinking shown by a significant value ($0.030 < 0.05$), the learning model has an effect on students' cognitive learning outcomes shown by a significant value ($0.000 < 0.05$). This means that the M-PBL learning model (Modified Problem Based Learning) is able to improve learning motivation, creative thinking skills, and cognitive learning results of class XI students of Senior High School 6 of Ambon.

The syntax of M-PBL learning model are based on constructive theory and could give chance for a student to develop their learning motivation, creative thinking and cognitive learning result. M-PBL learning model also could give a condition and learning atmosphere that quite different from than Discovery learning model that basically used as always by teachers out there. Therefore, further research needs to be done as an effort to find out and analyze other factors that contribute to influencing student motivation, creative thinking, and cognitive learning outcomes during learning using the M-PBL learning model.

Acknowledgments

The authors thank the Mayor of Ambon, which has provided scholarship assistance for the completion of this research in Study Program of Biology Education, Postgraduate, Pattimura University, year 2014/2015.

Biodata of the Author



Audrey Evelyn SAPTENNO was born in Ambon, Indonesia. She obtained a bachelor's degree in Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia. She is a teacher in Senior High School 6 of Ambon, Indonesia. Her research focusing on learning motivation and creative thinking skills.

Affiliation: Senior High School 6 of Ambon.

E-mail: audrysapteno@gmail.com

Phone: (+62) 81343021570

Orcid Number: 0000-0001-5991-4331



Hasan TUAPUTTY was born in Ambon, Indonesia. Primary and secondary education is completed at Ambon in Elementary School Al-Hilal 2 of Ambon (1972-1978), Public Middle School 4 of Ambon (1978-1980), and Public High School 1 of Ambon (1980-1983). Bachelor of Biology Education was achieved at the Faculty of Teacher Training and Education, Pattimura University (1984-1989). In 1995 he continued his studies at the Postgraduate of the State University of Malang, won a Masters

in Biology Education in 1998. In 2006, he attended S3 education at the Postgraduate

Program at the State University of Malang in the Biology Education Doctoral Program. His career as a teacher began in December 1991 until now. Besides teaching, the author is also active in conducting research in the field of biological learning. Several articles have been published in several journals and research papers have been presented at various seminar activities.

Affiliation: Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia.

E-mail: tuaputtyhasan123@gmail.com

Phone: (+62) 81233000402

Orcid Number: 0000-0002-0556-5102



Dominggus RUM AHLATU was born in Kairatu, Indonesia.

Primary and secondary education is completed at Kairatu in Elementary School 2 of Kairatu (1984-1989), Public Middle School 1 of Kairatu (1989-1992), and Public High School 1 of Kairatu (1992-1995). Bachelor of Biology Education was achieved at the Faculty of Teacher Training and Education, Pattimura University (1995-2001). In 2005 he continued his studies at the Postgraduate of the State University of Malang, won a Masters in Biology Education in 2007. In 2010, he attended S3 education at the Postgraduate Program at the State University of Malang in the Biology Education Doctoral Program. His career as a Lecturer began in December 2002 until now. Besides teaching, the author is also active in conducting research in the field of biological learning. Several articles have been published in several journals and research papers have been presented at various seminar activities.

Affiliation: Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia.

E-mail: dominggus_amq@yahoo.co.id

Phone: (+62) 81343007114

Orcid Number: 0000-0002-4466-5528



Pamela Mercy PAPILAYA was born in Ambon, Indonesia.

Primary and secondary education is completed at Ambon in Elementary School Xaverius D of Ambon (1973-1978), Public Middle School 2 of Ambon (1978-1981), and Public High School 1 of Ambon (1981-1984). Bachelor of Biology Education was achieved at the Faculty of Teacher Training and Education, Pattimura University (1984-1990). In 2005 she continued her studies at the Postgraduate of the State University of Malang, won a Masters in Biology Education in 2002. In 2007, she attended S3 education at the Postgraduate Program at the State University of Malang in the Biology Education Doctoral Program. Her career as a teacher began in December 1991 until now.

Besides teaching, the author is also active in conducting research in the field of biological learning. Several articles have been published in several journals and research papers have been presented at various seminar activities.

Affiliation: Study Program of Biology Education, Faculty of Teacher Training and Education, Pattimura University, Indonesia.

E-mail: joyfullpamela@yahoo.co.id

Phone: (+62) 81344040470

Orcid Number: 0000-0003-1055-128X

References

- Akinoglu, O., & Tandogan, R. O. (2007). The Effect of problem based active learning in science education on students' academic achievement, attitude and concept learning. *Eurasia Journal of Mathematics, science and Technology Education*, 3(1), 71-81. <https://doi.org/10.12973/ejmste/75375>.
- Ardiana, F. (2013). Pengaruh kemampuan akademik terhadap keterampilan metakognitif dan retensi siswa pada pembelajaran biologi kelas X dengan penerapan strategi Jigsaw [The Effect of Academic ability on students' metacognitive skills and retention on Biology learning class X with the implementation of Jigsaw learning strategy]. (Online), <http://karya-ilmiah.um.ac.id/index.php/biologi/article/view/27106>, accessed on July 28, 2018. (In Indonesian).
- Antika, L. T., Corebima, A. D., & Mahanal, S. (2013). Perbandingan keterampilan metakognitif, hasil belajar biologi, dan retensi antara siswa berkemampuan akademik tinggi dan rendah kelas X SMA di Malang melalui strategi problem based learning (PBL) [The comparison between metacognitive skills, biology learning results, and retention of upper and lower academic ability students]. (Online), jurnal-online.um.ac.id, accessed on July 30, 2018. (In Indonesian).
- Arif. (2016). Pengaruh Problem Based Learning (PBL) terhadap motivasi dan hasil belajar IPS siswa kelas VIII SMP Negeri 13 Mataram [The effect of Problem Based Learning (PBL) on motivation and social science learning results of class VIII Students of Junior High School 13 Mataram]. *Jurnal Historis*, 1(1), 51-57. (In Indonesian).
- Amin, M. (2016). Perkembangan biologi dan tantangan pembelajarannya [Biology development and learning chalanges]. *Prosiding Seminar Nasional Pendidikan Biologi dan Sainstek*, 1-11. (In Indonesian).
- Awang, H., & Ramly, I. (2008). Creative thinking skill approach through problem-based learning: Pedagogy and practice in the engineering classroom. *International Journal of Social Sciences*, 3(1), 18-23.
- Aydoğan, Y., Gültekin Akduman, G. & Kaynar, F. (2017). The factors affecting the Science Arts Center administrators. *Journal for the Education of Gifted Young Scientists*, 5(2), 41-52. DOI: <http://dx.doi.org/10.17478/JEGYS.2017.55>
- Aziz, A. Rokhmat, J., & Kosim. (2015). Pengaruh model pembelajaran berbasis masalah dengan metode eksperimen terhadap hasil belajar fisika siswa kelas X SMAN 1 Gunungsari Kabupaten Lombok Barat Tahun pelajaran 2014/2015 [The effect of problem based learning model on Physics learning results of Class X students of Senior High School 1 Gunungsari Lombok Barat in the 2014/2015 academic year]. *Jurnal*

- Pendidikan Fisika dan Teknologi*, 1(3), 200-204. <https://doi.org/10.29303/jpft.v1i3.259>. (In Indonesian).
- Azizi, A., Suciati., & Maridi. (2014). Pembelajaran biologi dengan model PBL dengan metode eksperimen disertai teknik “Vee Diagram” dan “Fishbone Diagram” ditinjau dari aktivitas dan kreativitas belajar siswa [Biology learning using PBL learning model with Experiment method accompanied with “Vee Diagram” and ‘Fishbone Diagram’ viewed from students’ learning activities and creativities]. *Jurnal Inkuiri*, 3(1), 8-18. <https://doi.org/10.20961/inkuiri.v3i01.9650>. (In Indonesian).
- Bahri, A., & Corebima, A. D. (2015). The contribution of learning motivation and metacognitive skill on cognitive learning outcome of students within different learning strategies. *Journal of Baltic Science Education*, 14(4), 487-500.
- Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms?. *Computers & Education*, 39(4), 395-414. [https://doi.org/10.1016/S0360-1315\(02\)00075-1](https://doi.org/10.1016/S0360-1315(02)00075-1).
- Budiningsih, C. A. (2004). *Pembelajaran moral berpijak pada karakteristik siswa dan budayanya* [Moral learning rests on the characteristics of students and cultures]. Jakarta: PT Rineka Cipta. (In Indonesian).
- Budiningsih, C. A. (2005). *Pengembangan model pembelajaran berbasis masalah-masalah komponen masukan instrumental untuk meningkatkan kualitas pembelajaran* [Development of problem-based learning models of instrumental input components to improve the quality of learning]. Jakarta: Dikti Program SP4. (In Indonesian).
- Burgess, A., Roberts, C., Ayton, T., & Mellis, C. (2018). Implementation of modified team-based learning within a problem based learning medical curriculum: a focus group study. *Medical Education*, 18(74), 2-7. <https://doi.org/10.1186/s12909-018-1172-8>.
- Darmawati, J. (2013). Pengaruh motivasi belajar dan gaya belajar terhadap prestasi belajar ekonomi siswa SMA Negeri Kota Tuban [The Effect of Learning Motivation and Learning Styles on Economics learning results of Senior High School Students of Kota Tuban]. *Jurnal Ekonomi dan Kewirausahaan*, 1(1), 79-90. <http://dx.doi.org/10.26740/jepk.v1n1.p79-90>. (In Indonesian).
- Daramola, D. S., Bello, M. B., Yusuf, A. R., & Omali, I. O. O. (2019). Creativity level of hearing impaired and hearing students of Federal College of Education. *International Journal of Instruction*, 12(1), 1489-1500. <https://doi.org/10.29333/iji.2019.12195a>.
- Daud, A. M., Omar, J., Turiman, P., & Osman, K. (2012). Creativity in Science Education. *Social and Behavioral Sciences*, 59, 467-474. <https://doi.org/10.1016/j.sbspro.2012.09.302>.
- Fakhriyah, R. (2014). Penerapan problem based learning dalam upaya mengembangkan kemampuan berpikir kritis mahasiswa [Improving students’ critical thinking skills by using problem based learning]. *Jurnal Pendidikan IPA Indonesia*, 3(1), 95-101. <https://doi.org/10.15294/jpii.v3i1.2906>. (In Indonesian).
- Gusmawati. (2013). Model pembelajaran role playing untuk meningkatkan hasil belajar biologi mahasiswa Program Studi Pendidikan Biologi FKIP Universitas Bung Hatta [Role playing learning model to improve biology learning results of the students of Biology Education Study program at FKIP Universitas Bung Hatta]. Proceeding of Seminar Nasional XI Pendidikan Biologi FKIP UNS. p. 789-794. (In Indonesian).

- Corebima, A. D. (2007). Learning Strategies To Empower Students Thinking Skill. *Proceeding of International Conference on Science and Mathematics Education (CosMed) SEAMEO RECSAM*, Malaysia, Nopember 13-16, 2007.
- DePorter. (2007). Quantum learning: membiasakan belajar nyaman & menyenangkan[Quantum Learning: being accustomed to comfortable & fun learning]. Bandung: PT. Mizah Pustaka. (In Indonesian).
- Hadiono., & Hidayati, N. A. (2016). Penerapan model pembelajaran discovery learning untuk meningkatkan motivasi dan hasil belajar siswa kelas VIII-D SMPN 2 Kamal materi cahaya[Improving learning motivation and learning results of class VIII-D of Junior High School 2 Kamal about Light learning material by using Discovery learning model]. *Jurnal Pena Sains*, 3(2), 77-84. (In Indonesian).
- Hayat, M. S., Sutarno., & Erwin. (2017). Lorong waktu revolusi saintifik pada era eksponensial [Time trail of Scientific revolution in Exponential Era]. *Titian Ilmu: Jurnal Ilmiah Multi Sciences*, 10(10), 41-50. <https://doi.org/10.30599/jti.v9i1.80>.(In Indonesian).
- Hasanah, U., Ertikanto, C., & Wahyudi, I. (2017). Perbandingan hasil belajar siswa menggunakan model discovery learning dengan problem based learning[The comparison between the learning results of the students taught by using discovery learning and problem based learning]. *Jurnal Pembelajaran Fisika*, 5(1), 109-120. (In Indonesian).
- Hinderasti, N. E. K., Suciati., & Prayitno, B. A. (2014). Pengaruh model pembelajaran *problem based learning* dengan metode eksperimen disertai teknik roundhouse diagram dan mind map terhadap hasil belajar biologi ditinjau dari gaya belajar dan motivasi belajar siswa[The effect of problem based learning with experimental method accompanied with Roundhouse Diagram and Mind Map technique on Biology learning results viewed from students' learning styles and learning motivation]. *Jurnal Biedukasi*, 6(2), 10-27. (In Indonesian).
- Hudec, R., Tisonova, J., Bozekova, L., Wawruch, M., Kriska, M., & Kristova, V. (2009). Modified problem-based learning in pharmacology. *Bratisl Lek Listy*, 110(11), 732-735.
- Iswadi, H. (2016). Sekelumit dari hasil PISA 2015 yang baru dirilis[A little of the results of PISA 2015]. (online). www.ubaya.ac.id. (In Indonesian).
- Joma, M. A. R., Al-Abed, S. F. M., & Nafi, J. S. I. (2016). The effect of "Role-playing" on students' achievement and motivation in the Governmental Schools of Bethlehem District in Palestine. *British Journal of Education, Society & Behavioural Science*, 18(3), 1-25. <https://doi.org/10.9734/BJESBS/2016/28782>.
- Karmana, I. W. (2011). Strategi pembelajaran, kemampuan akademik, kemampuan pemecahan masalah, dan hasil belajar biologi [Learning strategy, academic ability, problem solving skills, and biology learning results]. *Jurnal Ilmu Pendidikan*, 17(5), 378-386. <https://doi.org/10.17977/jip.v17i5.2866>.(In Indonesian).
- Kacan, S.D., & Sahin, F. (2018). The impact of scientific creative thinking skills on scientific process skills. *SHS Web of Conferences*, 48(2018):1-8.<https://doi.org/10.1051/shsconf/20184801060>.
- Kaeser, M. A., Kamper, J., & Hawk, C. (2014). Traditional versus a modified problem-based learning activity: is there a difference in student knowledge retention?. *Topics in Integrative Health Care*, 5(2), 1-11.

- Koh, J. H. L., Chai, C. S., & Tsai, C. C. (2014). Demographic factors, TPACK constructs, and Teachers' perceptions of constructivist-oriented TPACK. *Educational Technology & Society*, 17(1), 185–196.
- Kind, P. M., & Kind, V. (2007). Creativity in Science Education: Perspectives and Challenges for Developing School Science. *Studies in Science Education*, 43(1): 1-37. <https://doi.org/10.1080/03057260708560225>.
- Losos, J. B., Arnold, S. J., Bejerano, G., Brodie, E. D., Hibbett, D., Hoekstra, H. E., Mindell, D. P., Monteiro, A., Moritz, C., Orr, H. A., Petrov, D. A., Renner, S. S., Ricklefs, R. E., Soltis, P. S., & Turner, T. L. (2013). Evolutionary Biology for the 21st Century. *Plos Biology*, 11(1), 1-8. <https://doi.org/10.1371/journal.pbio.1001466>.
- Malahayati, E. N. (2016). Pembelajaran berbasis masalah melalui Think Pair Share terhadap Hasil Belajar Biologi dan Retensi Siswa [Problem based learning through Think Pair Share on Students' Biology Learning Results and Retention]. *Konstruktivisme: Jurnal Pendidikan dan Pembelajaran*, 8(2), 131-147. <https://doi.org/10.30957/konstruk.v8i2.45>.(In Indonesian).
- Mustami, M. K., & Safitri, D. (2018). The Effects of Numbered Heads Together-Assurance Relevance Interest Assessment Satisfaction on Students' Motivation. *International Journal of Instruction*, 11(3), 123-134. <https://doi.org/10.12973/iji.2018.1139a>.
- Najib, I. A., Suyatna, A., & Wahyudi, I. (2015). Pengaruh model pembelajaran problem based learning terhadap ketrampilan berpikir kreatif siswa SMP [The effect of problem based learning on creative thinking skills of Junior High School Students]. *Jurnal Pembelajaran Fisika*, 5(1), 73-82. (In Indonesian).
- Nafiah, Y. N. (2014). Penerapan model problem based learning untuk meningkatkan ketrampilan berpikir kritis dan hasil belajar siswa[Improving students' critical thinking skills and learning results by using problem based learning model]. *Jurnal Pendidikan Vokasi*, 4(1), 125-143. <https://doi.org/10.21831/jpv.v4i1.2540>.(In Indonesian).
- Nurcholis, A., Suciati, & Indrowati, M. (2013). Penerapan model problem based learning(PBL) disertai artikel ilmiah untuk meningkatkan kemampuan berpikir kreatif siswa kelas X3 SMAN 2 Boyolali Tahun Pelajaran 2012/2013 [Improving the creative thinking skills of class X3 Students of Senior High School 2 Boyolali in the 2012/2013 academic year]. *Bio-Pedagogi*, 2(2), 58-67. (In Indonesian).
- Olusegun, S., & Bada. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education*, 5(6), 66-70. <https://doi.org/10.9790/7388-05616670>.
- Ozyaprak, M. (2016). The effectiveness of SCAMPER technique on creative thinking skills. *Journal for the Education of Gifted Young Scientists*, 4(1), 31-40. <http://dx.doi.org/10.17478/JEGYS.2016116348>
- Pashler, H., McDaniel, M., Doug Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and Evidence. *Psychological Science in the Public Interest*, 9(3), 105-119. <https://doi.org/10.1111/j.1539-6053.2009.01038.x>.
- Puspitasari. (2012). Pengaruh Model problem based learning terhadap kemampuan berpikir kreatif siswa mata pelajaran biologi kelas X SMA Negeri 2 Surakarta Tahun Pelajaran 2011/2012 [The effect of problem based learning model on the creative thinking skills in biology learning of class X students of Senior High School 2 Surakarta in the 2011/2012 academic year]. *Skripsi*. (online), *biologi.fkip.uns.ac.id*. (In Indonesian).

- Primartadi, A. (2012). Pengaruh metode student teams-achievement division(STAD) dan problem based learning terhadap hasil belajar ditinjau daripotensi akademik siswaSMK Otomotif [The Effect of student teams-achievement division(STAD) and problem based learning on learning results viewed from the students' academic potential in SMK Otomotif]. *Jurnal Pendidikan Vokasi*, 2(2), 143-153. <https://doi.org/10.21831/jpv.v2i2.1024>.(In Indonesian).
- Pranoto., Harlita., & Santosa, S. (2017). Perbandingan model pembelajaran problem based learning dan guided discovery learning terhadap keaktifan siswa kelas X SMA [The comparison between problem based learning and guided discovery learning on the activeness of Senior High School students class X]. *JurnalBioedukasi*, 10(1), 18-22.<http://dx.doi.org/10.20961/bioedukasi-uns.v10i1.8604>. (In Indonesian).
- Pradnyana, P. B., Marhaeni, A. A. I. N., & Made, I. C. (2013). Pengaruh pembelajaran berbasis masalah terhadap motivasi belajar dan prestasi belajar matematika siswa kelas IV SD [The effect of problem based learning on learning motivation and mathematics learning achievement of class IV students of Elementary Schools]. *Journal Program Pascasarjana Universitas Pendidikan Ganesha*, 3(1), 1-10. (In Indonesian).
- Rahardjanto, A., Husamah., & Fauzi, A. (2019). Hybrid-PjBL: Learning outcomes, creative thinking skills, and learning motivation of preservice Teacher. *International Journal of Instruction*, 12(2), 179-192. <http://doi.org/10.29333/iji.2019.12212a>.
- Rizqi, A.D. (2014). Penggunaan model pembelajaran discovery learning untuk meningkatkan motivasi dan hasil belajar siswa pada tema Makananku Sehat dan Bergizi kelas IV [Improving students' motivation and learning results by using discovery learning model on the theme of My Healthy and Nutrious Food Class IV]. Skripsi. (Online), <http://repository.unpas.ac.id>, accessed on July 30, 2018. (In Indonesian).
- Sanjaya, W. (2006). *Strategi pembelajaran: Berorientasi standar proses pendidikan* [Learning Strategy: oriented on Education Process standard]. Jakarta: Kencana Prenada Media. (In Indonesian).
- Safitri, L. A., Rosidin, U., & Ertikanto, C. (2014). Hubungan kemampuan berpikir kreatif dan motivasi dengan hasil belajar melalui model PBL [The correlation between creative thinking skill and motivation toward learning results through the implementation of PBL learning model]. *Jurnal Pembelajaran Fisika*, 2(3), 107-118. (In Indonesian).
- Sihaloho, R. R., Sahyar., & Ginting, E. M. (2017). The effect of problem based learning (PBL) model toward student's creative thinking and problem solving ability in Senior High School. *Journal of Research & Method in Education*, 7(4), 11-18. <http://doi.org/10.9790/7388-0704011118>.
- Supiandi, M. I., & Julung, H. (2016). Pengaruh model problem based learning(PBL) terhadap kemampuan memecahkan masalah dan hasil belajar kognitif siswa biologiSMA [The effect of problem based learning on problem solving skills and biology cognitive learning results of Senior High School students]. *Jurnal Pendidikan Sains*, 4(2), 60-64. <http://dx.doi.org/10.17977/jps.v4i2.8183>.(In Indonesian).
- Susanto, J. 2012. Pengembangan perangkat pembelajaran berbasis lesson study dengan kooperatif tipe Numbered Heads Togetheruntuk meningkatkan aktivitas dan hasil belajar IPA di SD [Developing learning material based on lesson study using Numbered Heads Together to improve students' activities and science learning results in Elementary Schools]. *Journal of Primary Education*, 1(2), 71-77. (In Indonesian).
- Valle, R., Petra, I., Martinez-Gonzalez, A., Rojas-Ramirez, J. A., Morales-Lopez, S., & Pina-Garza, B. (1999). Assessment of student performance in problem-based learning tutorial sessions. *Medical Education*, 33, 818-822. <http://doi.org/10.1046/j.1365-2923.1999.00526.x>.
- Wahyuni, T., Akhirmen., & Areva, D. (2012). Faktor-faktor yang mempengaruhi motivasi belajar siswa Jurusan IPS mata pelajaran ekonomi kelas XI SMA N 6 Sijunjung [The factors affecting the learning motivation of social science students in the economics

- subject class XI of Senior High School 6 Sijunjung]. (Online), <http://id.portalgaruda.org>, accessed on July 30, 2018. (In Indonesian).
- Wang, Q., Li, H., Pang, W., Liang, S., & Su, Y. (2016). Developing an integrated framework of problem-based learning and coaching psychology for medical education: a participatory research. *BMC Medical Education*, *16*(2), 1-14. <http://doi.org/10.1186/s12909-015-0516-x>.
- Widyoko, E.P. (2012). *Teknik penyusunan instrumen penelitian [Research instrument technique]*. Yogyakarta: Pustaka Pelajar. (In Indonesian).