

IMPLEMENTATION OF PROJECT BASED LEARNING (PBL) MODEL FOR CRITICAL THINKING SKILLS AND CREATIVITY STIMULATION AS A PROSPECTIVE BIOLOGY TEACHER

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ABSTRACT

Recently, teachers play role in learning process; however, it does not mean they are the spear in the learning process. A teacher center paradigm that becaomes student center requires students to be more active and responsible in their assignment as a preparation to become a professional prospective teacher. The research is a qualitative and quantitative research aiming to observe the implementation of PjBL model for critical thinking skill and creativity stimulation of students as a prospective biology teacher. Correspondents in the research consist of 66 people divided into two groups, PjBL and non-PjBL groups. Assessment of observation result and learning outcome is conducted using percentage. The hypothesis testing for quantitative data analysis is done using t-test. The analysis result conclusion indicates that there is an influence of PjBL model implementation for critical thinking skills and creativity stimulation of students as a prospective biology teacher with significance of 0.05.

Keywords: Professional Prospective Biology Teacher, Critical Thinking Skills, Creativity, PjBL Model, Skill Development

INTRODUCTION

The 21st century civilization demands students to have critical thinking skills, communication skills, collaborative skills, and creative. The quality assurance priority program states the necessity of learners' readiness in facing the 21st century challenges (Sardjoko, 2016). The 21st century knowledge and skill content consists of: (1) thinking; (2) acting; dan (3) living in the world (Greenstein, (2012). The Nasional Research Council (2012) states that individuals need competences and critical thinking skill is one of them. A real life-based learning is required in the current century (Habok and Nagy, 2016). Rapid development of knowledge and technology requires the mastery of information technology and sciences. To face the technology advancement would require ability to obtain, select and process information that requires critical, systematic, logic and creative thinking.

Many efforts have been conducted to review contemporary issues and challenges faced in motivating learners to be fond of knowledge. Education field has an ever changing learning paradigm to achieve solution to produce better learning process, such as behaviorism, cognitivism and constructivism. It aims to elaborate relevant factors contributing to the cognitive, psychomotor and affective of current knowledge learning (Lay, 2016). The motivation theory states that learners who believe that success is related to efforts are more likely to do maximum efforts compared to those who believe that success is related to inherent abilities. When an individual has an ability and positive efforts they tend to choose to work on challenging assignments and are superior in academic achievement. Institutions and employment are currently not only emphasizing on educational qualification and skills but also they look for workers who could integrate body, mind and soul with work as well as able to cooperate well with their peers (Campus, 2017). Discussion on strategies in learning process becomes vital to improve and maintain current educational quality and it becomes the main consideration from various

education observers (Azkiyah, 2017). Teachers need to perform assessment in learning process including creativity assessment useful for diagnosing students' strengths and weaknesses as well as monitoring the students (Popham, 1995). Creative thinking is required in problem solving (Munandar, 1999).

Some studies have focused on PjBL, especially in primary and secondary level of education, such as Alacapinar (2008); Baki & Butuner (2009); Cakiroglu (2014); Cibik & Emrahoglu (2008), Erdem & Akkoyunlu (2002), Gomleksiz & Fidan (2012), Korkmaz & Kaptan (2002). Basyura, et al, (2015) in their research found that more than half of prospective teachers stated that they learn PjBL approach in theory but almost half of them assert that they don't have an opportunity to apply it. Despite many studies have been conducted that use PjBL model, problems in education world in terms of learning model selection is not over yet. It is due to several factors, for example discrepancy between learning model applied and content to be taught.

Facts show that critical thinking skills and creativity of Unsulbar students is basically low. The low student creativity could be related to input or process in learning in an educational institution. Expectation to be achieved in learning is producing skillful graduates in accordance with the 21st century demand. Based on the expectation, it is deemed necessary to find out students' critical thinking skills and creativity since early stage and apply a learning model that is considered as able to stimulate student skills. There are many researchers who have conducted research on how to improve learner creativity; however, none of them discuss about the use of PjBL model in evolution subject in order to improve students' critical thinking and creativity despite the subject that is closely related to students' daily life. In addition, students are struggling in learning the subject. Based on the issue, as a researcher, I am challenged to do something so as the evolution subject become an easily to learn subject.

Some learning skills need to be empowered in the 21st century education, such as communicative, collaborative, creative and critical thinking. Critical thinking skill includes

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in high-order thinking skills (Ikuonobe, 2001). Progress in knowledge and technology changes community structure and thinking (Gumus et al, 2013). The critical thinking skills needed should be implemented in learning process (Kealey et al, 2005). The skill should be implanted in each learner to response to very complex challenges (Halpern, 2003).

Belanger et al. (2011) argued that creativity is deemed as a psychological process to obtain experiences that can be made as a base to form new ideas in problem situation and there is no limit to keep practice. The creativity used is explained with 4P creativity, namely: process to analyze the occurrence of exploration to produce creativity; people to present different personality due to different research; product where creativity is an ability to produce something unique, the right novelty and valuable product (Daniel et al., 2012) and place to examine the environmental and performance effect. Creativity refers to intellectual characters or ability to make or create a certain original product that has good social and personal values as designed to achieve certain goals in mind by using information given based on one's potential (Hu & Adey, 2002). Activities that support creativity improvement could be conducted through creative experiments, solution search and creative activities.

Ennis explains five indicators of critical thinking skills, namely: develop simple explanation, develop basic skills, ask and answer questions, conclude, provide further explanation, arrange strategies and tactics. Zubaidah, dkk (2015) that modified Finken and Ennis's indicators, categorize critical thinking skill indicators into five including Focus, Supporting reason, Organization, Conventions and Integration (Browne dan Keeley, 2012). Critical thinking skills consist of five assessment indicators, namely: provide simple explanation, develop basic skills, conclude, further explanation and arrange strategies and tactics. Greenstein (2012) describes the critical thinking skill indicators as apply, evaluate, use data to develop critical thinking, analyze and synthesis. This research refers to the five critical thinking skill indicators of Greenstein since it is in accordance with the field condition.

Krulik & Rudnick (1999), Isaksen (2003) elaborate indicators in creative thinking level, namely: synthesize idea, develop idea, and apply idea. Greenstein (2012) classifies creative thinking indicators as Curiosity, Fluency, Originally, Elaboration, Imagination and Flexibility. Treffinger (2002) explain the creativity indicators to five indicators, namely: Fluency, Originality, Elaboration, Flexibility and Methaphorical. This research refers to Treffinger's (2002) indicators but only four of the five indicators, namely: Fluency, Originality, Elaboration and Flexibility since the researchers assume that the four indicators have been able to assess what will be assessed in the research. In addition, the researchers also adjust it to the field situation and condition in the research location. Based on the search on several articles, Ping (2016) wrote that his/her research on creativity was based on Huang's (2012) creativity indicators that consist of four indicators, namely: Fluency, Originality, Elaboration and Flexibility, that is going to be used in the research.

According to the researchers, the PjBL model is appropriate to be applied in college as an effort to improve student

creativity. One of learning models that could stimulate learner skills and is able to assess well is PjBL model. The PjBL model is not like other learning models that could assess all learning, both in process and learning outcome aspects. The PjBL model is one of learning model where in the end of the learning process it will result in a product in the form of a work produced by learners. The work will be one of basic assessment of the teacher to find out the achievement of desired skills. In addition to assessing learner abilities, through the learning model, teacher could assess learners' learning process since the learning model requires learners to be able to work collaboratively and independent (lecturer as a facilitator) based on their own experiences and knowledge. The PjBL model could provide breadth of learning for learners and it is implied that it could raise their self-awareness. Various ideas will emerge from within themselves so as curiosity to create something new will start to appear and become a start for the students to create something innovative.

RESEARCH METHOD

The research subjects involved students who just programmed evolution course consisted of 66 people that later divided into two classes. One class was an experimental class (PjBL group) and the other class was a control group (Non-PjBL group). The research design can be seen in Table 1.

Table 1. Quasi Eksperimental Research Design

R	X	Posttest
R		Posttest

Note:

R = Randomization

X = *Treatment (Project Based Learning)*

What to be assessed in the learning process was student attitude related to critical thinking skills and creativity. Assessment through observation was conducted during learning process by using pre-determined observation sheets. Assessment through learning outcome was done after the completion of the learning process by assessing posttest results of the correspondents based on the prepared rubric. Data on observation results and learning outcome (posttest) were analyzed with percentage scores and hypothesis testing was conducted using t-test. Other information required related to the research could be obtained through interview with the correspondents and lecturers.

RESULT AND DISCUSSION

A. Descriptive Analysis

1. Data Description

a. Learning Outcome

1. Critical Thinking Skills

Data analysis indicates that the use of PjBL model obtained higher result compared to those that did not use PjBL model. The percentage of learning outcome achievement after the learning process could be seen in Figure 1.

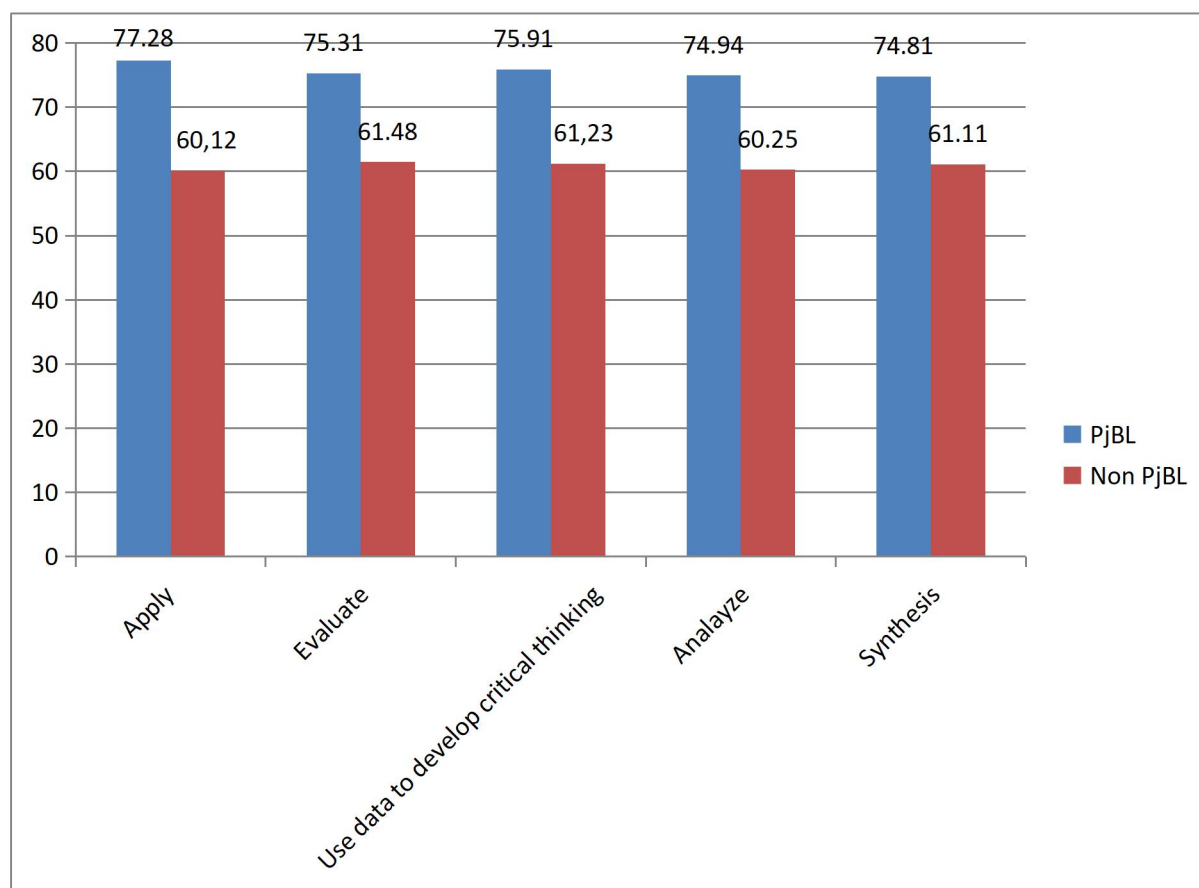


Figure 1. Data on Critical Thinking Skill Results of Students in PjBL and Non-PjBL groups

The percentage of data analysis result of the critical thinking ability based on the students' learning outcome indicates that the PjBL group had higher percentage than non PjBL group. Figure 1 shows that the highest achievement percentage in the PjBL group was 77.28% in apply indicator, whereas the lowest percentage was in synthesis indicator of 74.81%. Regarding the non-PjBL group, the highest percentage was in evaluate indicator of 61.48% and the lowest was in synthesis indicator of 61.11%.

Apply indicator achieved a percentage of 77.28% in answering questions presented to the students. It indicates that students had been shrewd in using their inquiry result data. Answering questions by involving the inquiry result data is a good way to answer question since the data are the real proof of an inquiry. Indicators with the lowest percentage in answering questions given did not mean that students were lack in using information/data from a variety of sources and prior experiences related to the real world situation since the percentage was in a high category.

A research conducted to find out students' critical thinking skills was done by performing learning using PjBL model. In this model, students are required to work independently and in a group to produce a learning result project. The lecturer acts as a mentor and students are the learning center. The National Research Center (NRC) issues several standards and states that inquiry is a good base for science education (NRC, 1996; 2000). Teachers consider students as lack of knowledge thus they need to be informed. Conventional teachers view that learning process will not run if there is no teacher (Novak, 1998). Learning, however, requires a good method to collect data to be used as an information source (Cheng, 2009). Cheng (2009) stated that a method used in learning process should reflect students' real daily life.

The spread of internet in the whole world not only brings opportunities for large businesses but also it could be used

for education. The benefits are not limited by space and time. Almost all colleges actively install tools for internet smoothness. It can be used by students to explore knowledge without a face to face meeting with lecturers. E-learning becomes one of modern learning alternative spaces that provides a virtual learning community (Lin & Cheng, 2009). Independent learning by students could improve student thinking skills. A web-based is deemed as a learning strategy emphasizing on learners to be able to play role as a student and moderator or student interactive learning.

2. Creativity

The result of data analysis on creativity in answering questions after the learning process indicate higher scores in the PjBL group than in non-PjBL group. The percentage data of learning outcome creativity can be seen in Figure 2.

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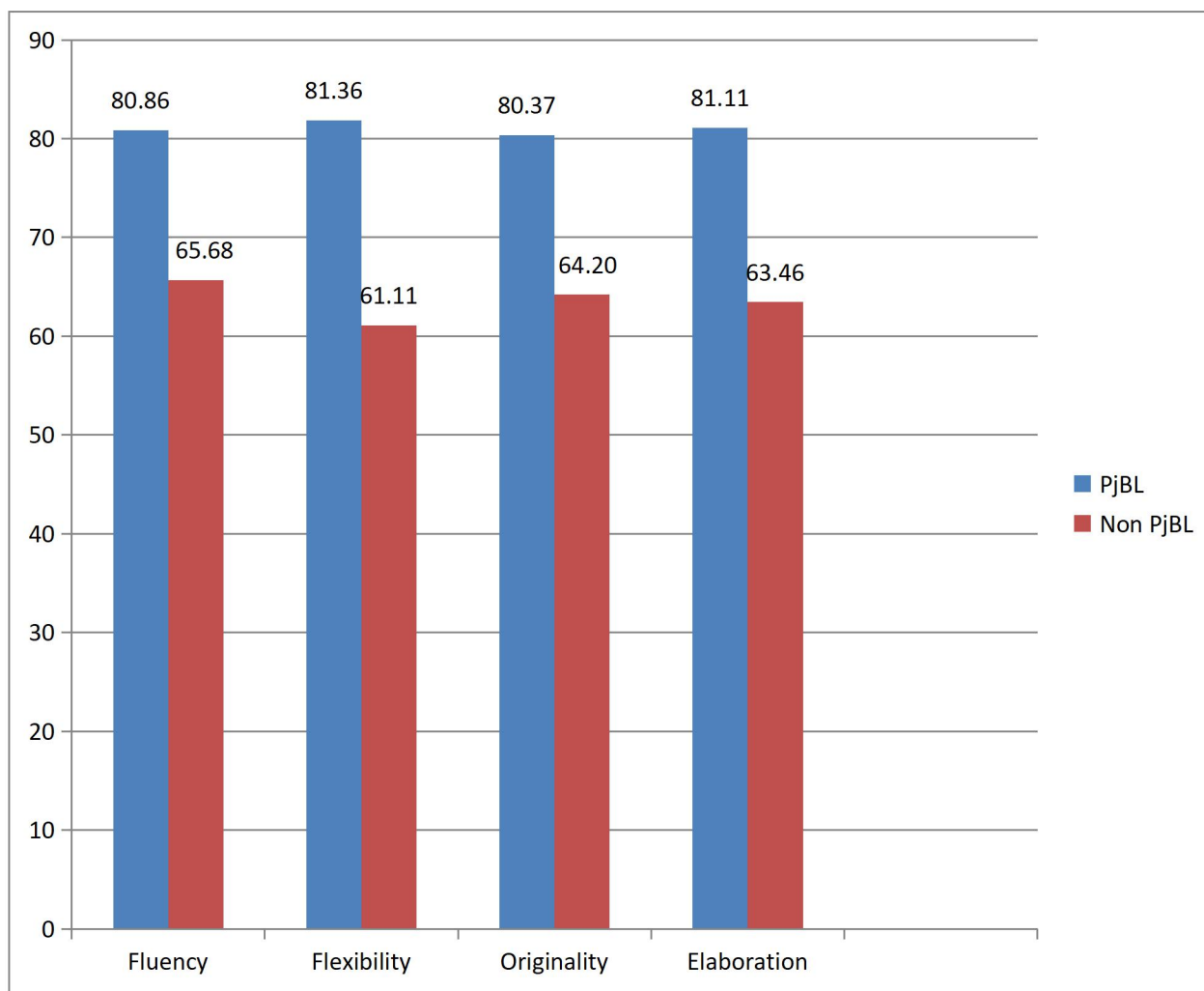


Figure 2. Data on Learning Outcome Creativity of Students in PjBL and Non-PjBL Groups

The creativity percentage obtained from the learning outcome analysis indicates that data of student learning outcome creativity gained shows that the PjBL group had the highest achievement percentage of 81.36% in flexibility indicator, whereas in the non-PjBL group the highest percentage of 65.68 was obtained in fluency indicator. Elaboration indicator that had the highest percentage in the creativity indicates that students could understand well on what they learned. Answering questions in detail and logic signified that the learning model used could function well in its implementation.

Clark & Mayer (2011) considered creativity performance as an interaction between relative skills, creativity-related skills and work motivation. Flisher (2010) indicates creativity as an interaction process between individuals, domains and field. Huang et al. (2012) explained that creativity is a transformation of individual or group on knowledge that allows someone to create a field so as able to conduct better changes. Creativity generally contains several cognitive abilities of divergent thinking that is understandable through testing tools or evaluator observation (Hawi, 2012).

A shift from primitive age to civilization has made people experiences millennium changes, such as industrial revolution and computer and technology invention that proves human intelligence (Singh, 2015). One's intelligence could not be obtained in a short time but it goes through many uneasy processes and thought; therefore, teachers today are expected to be able to create reliable generation by equipping students with skills to face the 21st century. It can be started from the teacher's teaching method. At present,

teachers have various methods to make students to be effective in learning process, for example by using a learning model that requires students to look for their own answers. Active students are common at present. Internet distribution up to remote areas could become a media for students to learn independently. Teacher-centered learning is a traditional learning and it could and easily generate obstacles, critics and worries, limited free thinking and no free speech (Huang et al., 2013). Spek et al. (2011) indicated that technology and information development as well as network improvement offers a suitable environment for E-learning.

b. Observation

1. Critical Thinking Skills

The result of observation data analysis indicates that the use of PjBL model gave influence on learning process. The percentage of observation result data shows that critical thinking skill in PjBL group was higher than non-PjBL. The result of learning process observation can be seen in Figure 3.

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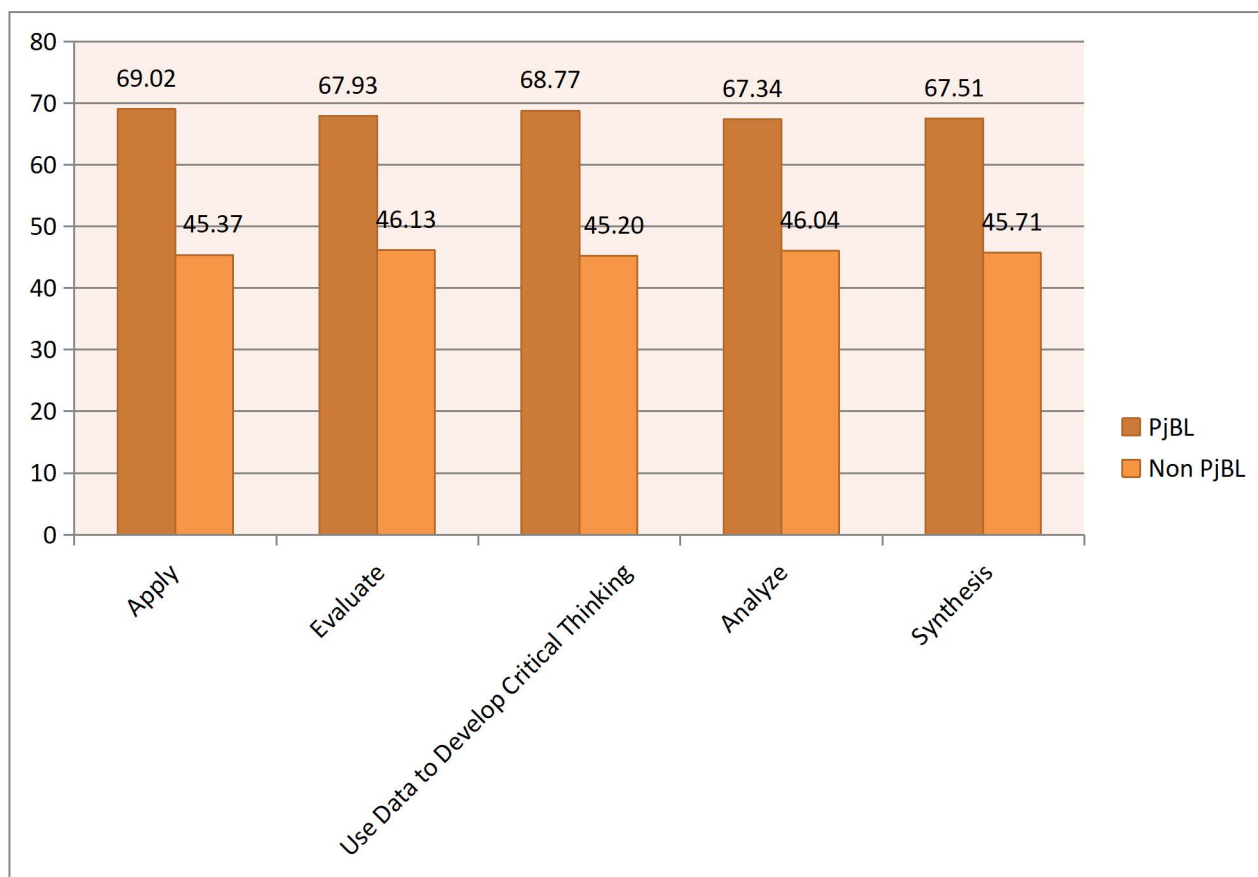


Figure 3. Comparison of Observation Result Data of Critical Thinking Skills in PjBL and Non PjBL Groups

The average of observation result data in PjBL group and Non-PjBL group in Table 4 indicates differences. The average scores of students' critical thinking skill percentage results based on observation in the PjBL group was 69.02% in apply indicator and the lowest percentage of 67.34% was in analyze indicator. In the non-PjBL group, the highest score was 46.13% in evaluate indicator, whereas the lowest was 45.20% in indicator of use data to develop critical thinking.

Based on the observation result on PjBL class and Non-PjBL class it shows a significant difference in terms of ability. In the PjBL group, apply indicator had the highest percentage. It is in accordance with several theories stating that applying students' learning finding in the daily life situation is important in learning objectives. The main goal of PjBL is to allow students to create solution-oriented products for new situation they face in the real life (Basyura, at.al, 2016). Demirhan and Demirel (2003) stressed that PjBL uses interdisciplinary approach. PjBL is based on student learning process in a variety of real life problems so as they could look for solution and are able to do presentation on their own project assignment (Ay, 2013).

Winn (1997) explained that PjBL provides better topic understanding since project learning gives opportunity for students on life lesson in the real life. PjBL is identical to a learning that produces a project design that requires thinking and information of knowledge to solve problem (Basyura, 2016). The main goals in PjBL are to achieve skills and

knowledge of information obtained from various media to solve a project (Ruangrit, 2009). One of learning that allows students is by preparing students with a meaningful learning and providing them an enjoyable learning experience (McBurney, 1995; McConnell & Marton, 2011) and challenging them to make an investigation to train to solve problem in daily life. Hence, students could follow the learning process as a whole and announce their finding (Winn, 1995). Further, they make prediction, phenomenon and solve problems. Students could do that and become an expert in using the process through an emphasis on science education (Carin, et al, 2005).

2. Creativity

The result of observation data analysis indicates differences in PjBL and Non-PjBL groups. The percentage of observation result on PjBL group was higher than those in Non-PjBL group. The differences in results for both groups are presented in Figure 4.

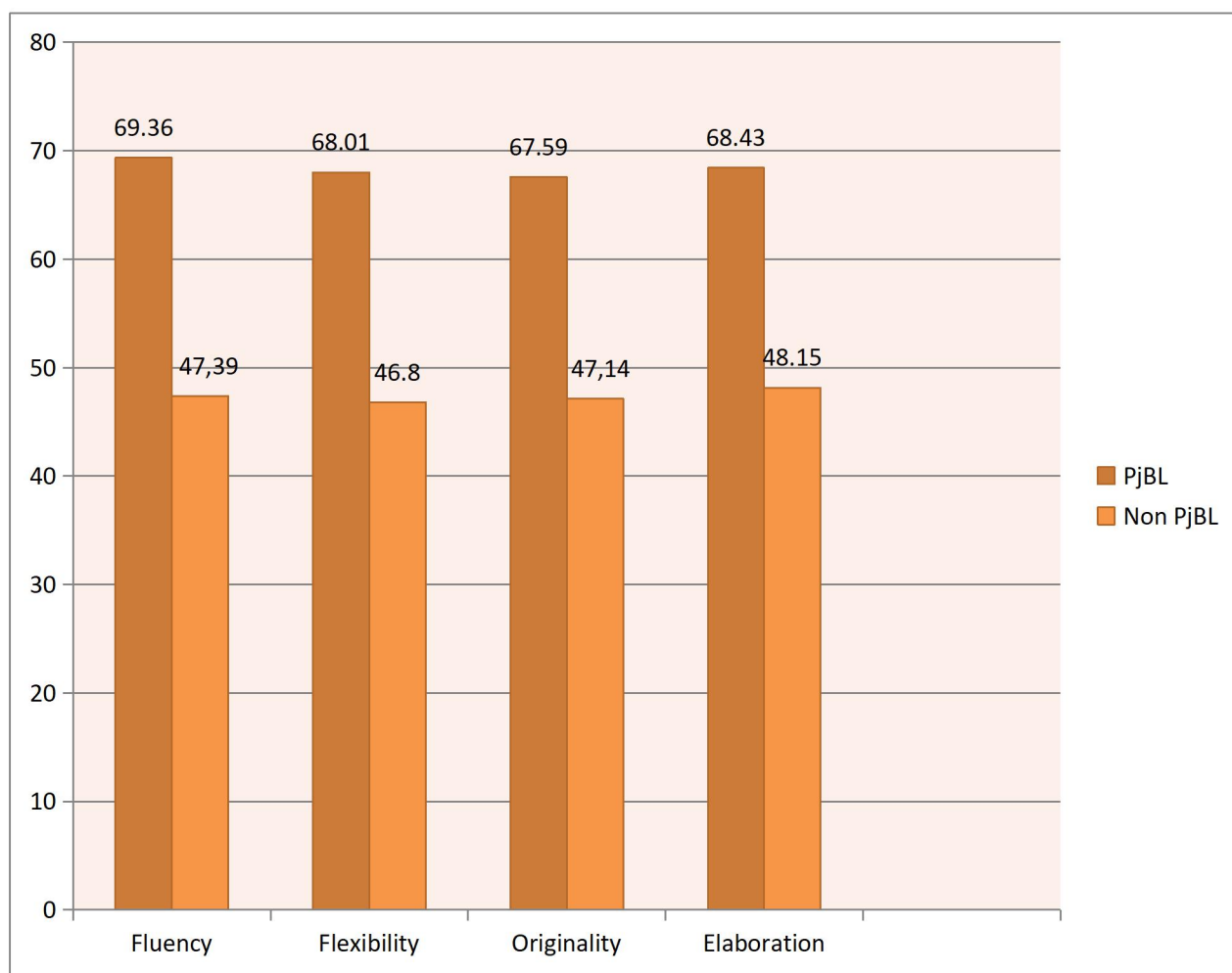


Figure 4. Comparison of Creativity Observation Result Data in PjBL and Non-PjBL Group

The average observation result data in PjBL group and non-PjBL group in Figure 4 indicates differences in the average data in both groups. The average score of students' creativity value based on observation shows that in PjBL group the highest was 69.36% in fluency indicator, whereas in non-PjBL group was 48.15% in elaboration indicator.

Seo & Woo (2010) found that different thinking style will indeed influence individual creativity. Most studies (Irwin et al, 2012;. Jeong, 2011; Joo et al, 2011) found better creativity performance from people with intelligent thinking style. Terzis & Economides (2011) exhibited correlation between thinking style and creativity of learners. Many people consider that education obliges a lot of knowledge but neglects creative teaching ability; thus, student memory fills with knowledge due to less practice (Carol et al., 2010). Anja Bockers et al. (2014) considered creativity as an ability to feel deficit of an object, shape and to test new hypothesis and communicate the result. Creativity is a divergent thinking ability referring to smoothness, flexibility and thinking uniqueness, sensitivity to problems and changes the existing ideas (de la Torre, 2011). Sheu & Chen (2014) stated that abilities to think and to be creative are considered as an ability to find the truth, problems and ideas to look for solution. Gough et al. (2014) showed that creation is utilized

as a thinking ability to explore to produce new things with unique performance that is sensitive, smooth and flexible. Yakar and Baykara (2014) explained that creative thinking consists of smoothness, flexibility and unique. Jones (2011) defined creativity as personality characteristic, ability, mental process and thinking behavior as an individual who has curiosity, adventurer, brave and imaginary, flexible and unique to think about problem through psychological activities to present object novelty and uniqueness.

a. Questionnaire

1. Critical Thinking Skills

Re-evaluation was conducted once the research completed on the learning process implementation through student response questionnaire on critical thinking skill variable. The result of student questionnaire percentage data is presented in Figure 5.

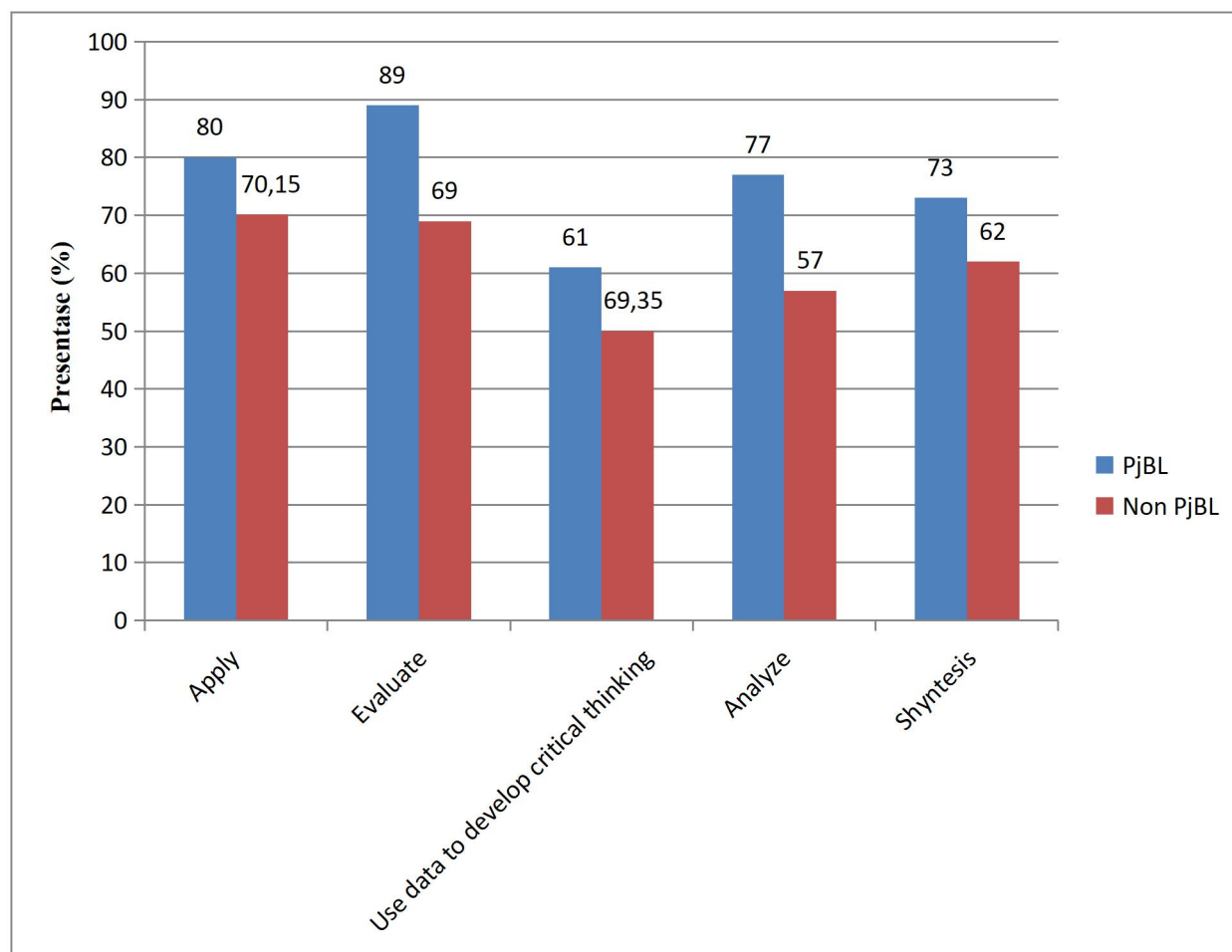


Figure 5. Differences in Critical Thinking Skills based on the Questionnaire Results between PjBL and Non PjBL Groups

Figure 5 illustrates that indicator of build basic skills in the PjBL group had the highest percentage of 89%, whereas the lowest was in conclude indicator with percentage of 61%. In the non-PjBL group the highest percentage was 73% in arrange strategies and tactics indicator, whereas the lowest was in conclude indicator of 50%.

Based on the result of student response data, students in the PjBL group felt that they had more ability in critical thinking compared to the Non-PjBL group. It can be seen from Figure 3 that in the percentage of each critical thinking indicator, the percentage of PjBL group response was higher than those of non-PjBL group. It indicates that the PjBL model used could improve and stimulate students courage to express what they knew, made students more critical, more systematic and directed in understanding each learning step. In detail, the result of questionnaire distribution analysis had an inequality value between respondents. Some respondents had too high values, whereas the other had too low values. It was due to several factors including respondents' lack of seriousness and inaccuracy in filling the questionnaire.

The questionnaire distribution main finding on critical thinking was that students' critical thinking skills in evolution course required some improvement, especially in terms of learning model used. The low students' critical thinking skill is something that requires attention, especially from education actors. It is in line with Nasution's (2008)

theory that thinking ability is a tool to achieve education goals so that learners are capable of solving high level problems. Critical thinking means a thinking strength that needs to be built among students so that it becomes a character or personality imprinted within the student life to solve all problems in their life. Students could use critical thinkig ability to look at different opinions as a foundation and direct decision making (Zubaidah *dkk*, 2015; Johnson, 2009). Critical thinking skill empowerment in students needs to be prioritized that can be integrated through learning methods proven capable of empowering student critical thinking skill.

2. Creativity

Upon the completion of the research, the researcher team performed reevaluation on the learning process implementation through student response questionnaire on the implementation of creativity assessment on students. The results of student questionnaire data analysis are presented in Figure 6.

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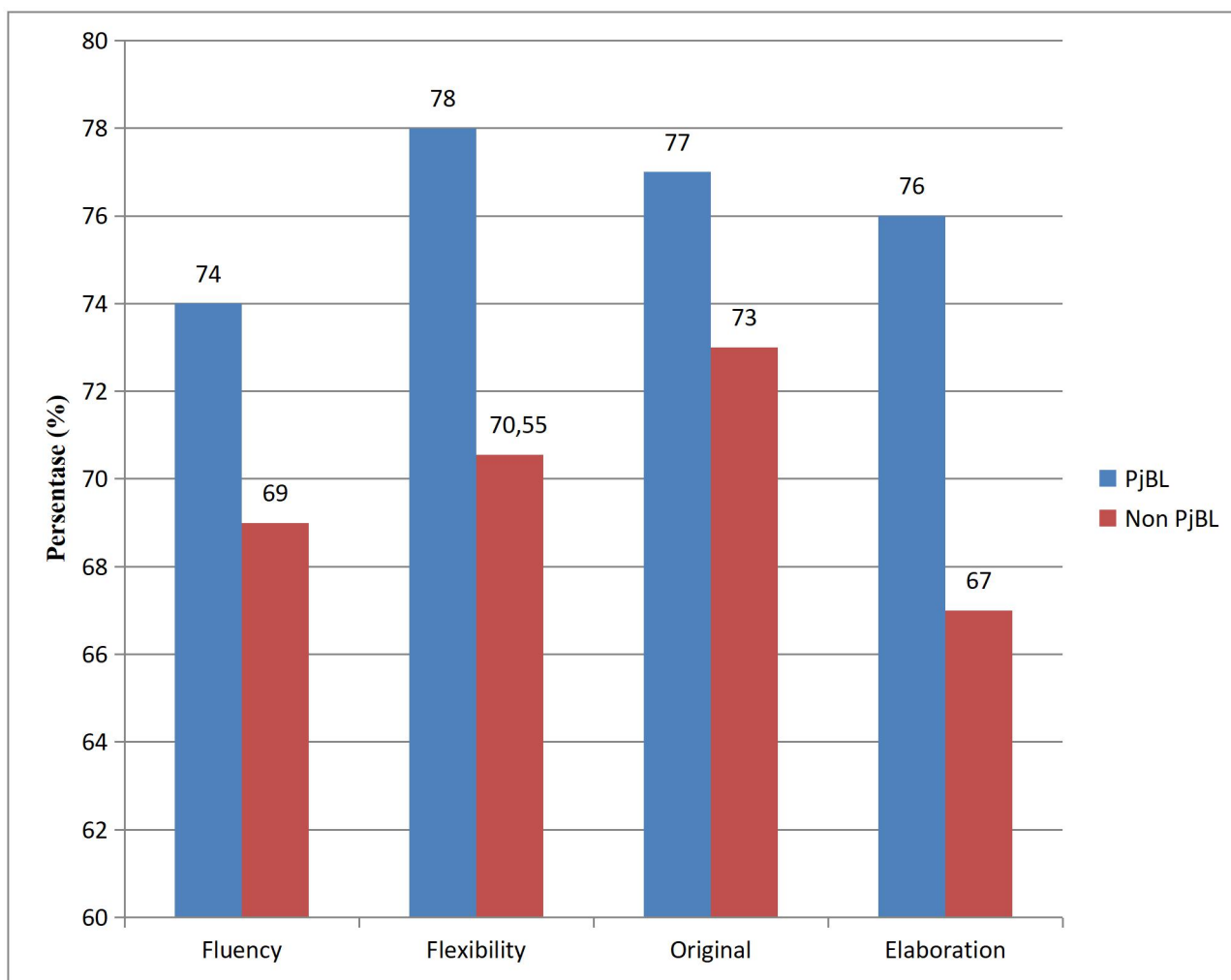


Figure 6: Differences in Creativity based on Questionnaire Results between PjBL and Non PjBL Groups

Figure 6 indicates that flexibility indicator in the PjBL group had the highest percentage of 78%, whereas the lowest was in fluency indicator of 74%. In the non-PjBL group, the highest percentage was 73% in original indicator, whereas the lowest was 67% in elaboration indicator.

The result of questionnaire data on students indicates that in the PjBL group flexibility had the highest percentage. It implies that students opined that learning with PjBL is a flexible learning and it make students more flexible and do not bound in learning. Fluency indicator was an indicator with the lowest percentage in the PjBL group; the percentage, however, was still within high category. In the Non-PjBL group, all indicators were lower than those in PjBL group; however, it was not within low category. It was due to their lack of understanding of the creativity indicators when filling out the questionnaire. In the beginning of learning, the researchers only introduced creativity indicators in detail to the PjBL group.

It is in accordance with theories stated by previous researchers. Sternberg dan Lubart (1995) showed that thinking style has no good or bad problem; instead it is adjusted to problems, demands, and situations. Coiro (2011) classified human thinking style into synthesist, idealist, pragmatist, analyst and realist and considered that people tend to think in certain ways that they think are appropriate

and even ignore others. Students with thinking style that is unusual than what they usually conduct at school will find difficulty to develop their abilities (Lin et al., 2012)

B. Inferential Analysis

1. Hypothesis Testing

a. Critical Thinking Skills

Based on the result of normality and homogeneity tests it can be concluded that data were normally distributed and the variance of both groups was homogeny; therefore, t-test could be performed. The hypothesis testing of the influence of learning model on concept mastery score was conducted using t-test. Interpretation on the existence of the influence of learning model on concept mastery could be known by comparing significance values (sig2-tailed) obtained from the result of alpha value of 5% (0.05).

Summary of the data analysis results conducted to explain the influence of project learning activity in evolution course on creativity of students of prospective biology teacher is presented in Table 2.

Table 2. Summary of Analysis of Project Learning Activity on Critical Thinking Skills Prospective Biology Teacher Students

Independent Samples Test				
		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference

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Hasil Belajar KBK	Equal variances assumed	98	,000	-13,20120
	Equal variances not assumed	87,376	,000	-13,20120

Based on the result of difference hypothesis testing (t-test) in critical thinking ability data in Table 2, the significance value was $0.000 < 0.05$. Therefore, there was a difference in critical thinking ability between the PjBL and non-PjBL groups.

The learning model used in the learning was PjBL model. Students were required to work cooperatively with work team and teacher was the mentor. Students were required to explore knowledge in their own way and linked them to the real life. The important thing in the learning was students could produce a project in the end of learning. Students could extract information from any sources, communities or media, especially internet. Slavin (1995) found that students who are asked to learn cooperatively are easier to understand. Cooperative learning could promote student learning outcome and improve comprehension and problem solving abilities. Johnson & Johnson (1996) assumed that team discussion allows members to explain to others, find solution and carry on discussion and debate to obtain a high level thinking ability development and improve learning outcome. However, in comparison to the teacher-centered method, inquiry-based teaching method is deemed effective in improving achievement and scientific process skill by encouraging students to find new information and encourage their critical thinking ability (Koksals 2008; Blanchard et al, 2010).

Chiang and Lee (2016) stated that project learning could also create environment that assists students to build meaningful knowledge, active and a student-centered learning as well as build students to collaborative and is able to encourage problem solving in relevant knowledge and skills.

Based on t-test that indicated a value of $0.000 < 0.05$ suggesting that the use of PjBL model gave influence on learning process. Several factors causing the existence of differences in critical thinking abilities between the two groups including in the experimental class students were demanded to think more in working on assignments given by the lecturer. Students were demanded to work on many assignments that must be completed in a certain period based on the PjBL learning model stage. According to opinion from several students obtained from interview, students were happy and motivated in completing their assignment since they got freedom in the process and it could be done inside and outside the classroom. The freedom made students excited because there was no pressure. In completing the project assignment, students worked in group and lecturer acted as a facilitator as well as motivator.

Differences in the value was also caused by experimental class that was more reflective, productive, focus and systematic in completing the assignment. It is in accordance with theories stated by Santrock (2010); Greenstain (2012); Johnson (2009); Ennis (2001); Facione (2013) that critical thinking is a reflective and productive reasoning ability to find solution for self confidence; therefore problems could be solved systematically and focus on activities conducted. The critical thinking skills from both groups were not significantly different. It is similar to a research by Masek and Yamin (2011) that in terms of critical thinking skills, abilities obtained by both groups were not significantly different. It was related to the existence of various sources or references that can be made as guidelines to obtain knowledge. Differences in work in both groups rested on the learning model used. In the control class, students were also demanded to complete assignments; however, they were guided and under the supervision of the lecturer. The learning was conducted in classroom with discussion method. The students and lecturers answered questions asked by

students or the lecturer her/himself stimulated students with questions referred to certain subjects. The students also referred to books prepared by the lecture; therefore they were not maximal in independent thinking. They tended to be passive in learning so as their critical thinking ability was less.

A good thinker could read a problem and decide how to start, whereas someone who could not think well will hard to read problem let alone find a way to solve problem. Someone who could think critically will use experiences and knowledge to solve problem and produce works according to the thinking result. One's critical thinking ability produces work systematically and is confidence in performing a process. On the contrary, someone who could not think critically has lack of or inability in knowledge and they work unsystematically; thus, the resulted work is less satisfying. In addition, he/she tends to solve difficulties and he/she is not productive and less creative in brings up ideas. Students opined that their resulted products were part of their knowledge and daily learning experience and in accordance with the evolution subject presented. It made them freer to implement their ideas and knowledge so as the product was purely from their collaborative work ideas. Ideas obtained by the students were sometimes combined with information generated from internet. Their products were different although some of them were similar.

In the beginning of learning, students found difficulties in determining projects to be worked on; however, based on books and LKM (student worksheet) containing project implementation procedures, students started to understand on what they were going to do. One student weakness in the learning was their lack of understanding on learning direction that confused them in working on assignments from the lecturers. Students would be troubled in the learning process when they have no learning guidance. According to them, the most difficult thing was when they were asked to make a new learning product (a learning product that never been created by someone before). After several meetings, they got used to their assignment. The result of PjBL model implementation made the students more motivated to be creative thus they would require more critical thinking. Positive responses were indicated by students regarding the implementation of the PjBL model. According to them they could work creatively based on their own knowledge and experiences; thus, they were more flexible in learning. As a facilitator and motivator, the lecturer kept performing guidance and supervision in

student learning process so as the learning outcome resulted was in accordance with the learning objectives. PjBL also had

some weaknesses. The learning model was time-consuming and students could roam off-topic when the project limits were unclear. In addition, it might be costly and hard for the students who had lack of information on scientific research methods. Some problems might incur in student individual assessment or family might expect a teacher-centered learning-based approach; however, they were not equipped with skills and knowledge to manage PjBL (Demirhan & Demirel, 2003).

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creativity of prospective biology teacher students is presented in Table 3.

2) Creativity

The summary of data analysis result conducted to explain the influence of project learning activity in evolution course on

Table 3. Summary of Analysis of Project Learning Activities on Prospective Biology Teacher Students

Independent Samples Test				
		t-test for Equality of Means		
		Df	Sig. (2-tailed)	Mean Difference
Hasil Belajar Siswa	Equal variances assumed	78	,000	-14,99750
	Equal variances not assumed	59,237	,000	-14,99750

According to the result of difference hypothesis test (t-test), creativity data in Table 6 obtained a significance value of $0.00 < 0.05$. It can be concluded that there was a difference in creativity between PjBL group and non-PjBL group.

Based on the research results by Ping (2016) it was suggested that teachers could change their teaching methods to stimulate student creativity. Hossein Khodabakhshza (2018) found that creativity had a significant relationship with teachers' teaching effectiveness. Teachers must become a creative teacher when they are an instructor. Teacher's teaching effectiveness could be observed from their previous teaching practice in the daily learning process. Hossein Khodabakhshza's (2018) research revealed that there was a significant difference between gender and teacher creativity where women were more creative in teaching compared to men. Teachers were suggested to assist students to understand their thinking style through observation on student daily behavior so as students could understand their own thinking style to develop their abilities and potentials. Creativity is an important human resource to strengthen competitive advantages in current global era. Comprehensive stimulates creativity in a planned way, which is an important thing. Innovation could be deemed as a knowledge production process, knowledge utilization and knowledge distribution, whereas creativity is the trigger of innovation. Therefore, education prioritizing on skills including creativity is one of keys to embrace the 21st century.

Project learning is an independent learning that provides an opportunity for students to be able to solve real-life problems; thus, students must look for their own answer to solve the problems. The current modern time provides easiness for students to complete assignments from their teacher. In completing the assignments they could obtain from many information media, especially environmental media and internet. Teachers and students could easily obtain real time information from the internet in an interactive process of learning activities. The instant, positive methods could be found in education environment through various ways such as internet, audio or video conference, electronic blackboard, chat room and stream media (Cheung et al., 2011). Therefore, learning process not only takes place in the classroom but also outside the classroom without depending on teachers.

Based on the research result data from several data collection methods, the use of PjBL gave better effect compared to those without the use of the PjBL. Some factors causing the differences in abilities between the experimental and control classes were students in the experimental class were given assignments that made them work better and serious to complete assignments given by the lecturers, which was different in the non PjBL class. Students were required to complete several assignments in a certain period of time based on PjBL model stages. According to opinions from several lecturers and students obtained through interview, students felt excited and had high motivation to complete the assignments. It was because they felt to be given a freedom to learn without strict rules and supervision from the lecturer. The learning process could be performed anywhere and anytime and students enjoyed the method. The freedom made

them more motivated and they felt less pressure from anyone. One thing enjoyed by them was they felt that the learning was like a game they played with their school mates, which was unlike in the classroom that was very formal. The PjBL model merely asked students to solve problems with many sources and required them to work cooperatively and collaboratively with their friends. Their assignments were mostly obtained from internet and the communities. The lecturer, who acted as a facilitator, motivator and mentor, felt glad because they did not have to elaborate at length to the students which took a lot of time. According to the lecturers, long explanation could bore students and make them confused. Students in the treatment group stated most positive opinion on the use of project-based learning method. On the contrary, someone who could not think critically have lack of or inability in knowledge, they work less systematically; therefore, their product is less satisfying. In addition, he/she tends to solve difficulties and he/she is not productive and less creative in brings up ideas. Creative thinking process is generally coordinated with student learning experience (Airasan, 2001) as indicated in every creativity indicators. Each indicator had high complexity in expressing and cumulating student ideas. Those ideas originated from learning experiences both in the classroom and outside the classroom or based from experiences they previously gained that they memorized and deeply thought. Learning through PjBL model based on daily experiences could generate curiosity among the students on what they will produce later; thus, they compete to make the best learning outcome project. The students could have similar or different ideas and they were free to produce anything according to their thought and were adjusted to certain content in each meeting. They make a project related to evolution subject; thus, easier and memorable knowledge understanding process. Imagination in generating student ideas was a necessity for a creative student.

Student experience and ability to process known knowledge provided influence on student creative process. Students used imagination and paid attention on intuition in linking knowledge to one another, as stated by Johnson (2002) that creative thinking involves experience. Ruggiero (1998) explained that effective thinking comes from a habit. Thinking quality brings better thinking ability and the quality can be achieved by anyone. The fact in the research shows that students who learned using PjBL model were able to make thinking as a habit. It was supported by the fact that not all learning models are able to raise or stimulate student creativity in learning. Different to the critical thinking skills, student creativity in the experimental and control classes were quite different. It was due to the experimental class that was required to produce a product that could stimulate creativity and add student experience.

Students opined that products they produced were the result of their knowledge and experiences they had learned every

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day and in accordance with the evolution content presented. It made them freer in pouring their ideas and knowledge; thus what they produced was truly come from their collaborative work idea. Those ideas obtained by the students were sometimes combined with information they generated from the internet. Their products were different but some of them were similar. Students' creativity in the control class tended to be lower than those in the experimental class. The reason was related to the differences in student involvement in the learning process. Students in the experimental class were more actively involved. Their experiences and freedom to work could solve problems in the learning. The research was in line with a research by Chiang & Lee (2016) stated that project-based learning is not only improve student learning motivation but also facilitates student's problem solving ability. Creative thinking involves curiosity; hence, learning based on a contextual teaching learning (CTL) becomes one of characteristics of PjBL model that is deemed as suitable to improve student creativity. CTL teaching system offers many opportunities for students to make creative thinking as a habit (Johnson, 2007).

According to the students' response data result, students in the experimental class felt that they had more abilities compared to their peers in the control class. It implies that the PjBL model used could improve and stimulate student courage to state what they knew. Additionally, it made students more creative, systematic and directed in understanding every learning steps. In detail, the questionnaire distribution result had inequality value between respondents. Some respondents had too high values, whereas the others had too low values. It caused by several factors, for example respondents' lack of seriousness and inaccuracy in filling the questionnaire. (Basyura, 2015) indicated that many prospective teachers who were familiar with PjBL approach still faced difficulties in its implementation and skill and knowledge in the management which might be the cause; therefore, a deepening in PjBL is a necessity through, such as, training so as to provide opportunities for them to use and apply the approach.

In the beginning of learning, students distressed about working on the assignments given by the lecturer and in terms of what projects they would produce and their learning sources. In this period also students asked a lot of questions and shared with their friends and teachers on the assignments they were working on. They finally referred more to the internet while remaining guided by books and LKM that put out procedures of project implementation. Eventually, they started to understand on what they were going to do. One student weakness in the learning was when they did not understand the learning direction; therefore, they became confused in carrying out the lecturer orders. They would struggle in the learning process if they did not have learning guidance. Creative thinking is needed in problem solving (Munandar, 1999). According to the students, the most difficult matter was when they were asked to create a new learning product. After several meetings, they got used to their assignments. The result of PjBL model implementation made them more motivated to be creative. Creativity assessment in the learning process serves to diagnose strengths and weaknesses as well as to monitor students (Popham, 1995)

During the learning process, students showed positive responses. Curiosity level was higher thus they often asked about the continuation of their assignment completion. They always gave the best through their new creations based on their own knowledge and experiences and they could work cooperatively as well as stayed collaborative in order to

produce maximal product. Lecturer as a mentor maintained their control over the students to minimize problems when students did not understand; thus their learning outcome produced will be in accordance with the learning objectives.

CONCLUSION

Based on the research result, it can be concluded that:

1. There was an influence of the implementation of PjBL model on critical thinking skills of prospective biology teachers
2. There was an influence of the implementation of PjBL model on creativity of prospective biology teachers
3. The implementation of project learning could make the prospective biology teachers to understand more on learning based on their own innovation.

SUGGESTION

It is expected that researchers who will conduct similar research to use more varied subjects, such as using sample from several different colleges since the research results influence by several factors thus varied results could be observed.

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