

# The Effectiveness of Problem-Based Learning on Biology Concept Gaining of Senior High School Multiethnic Students in Samarinda, Indonesia

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**Abstract**— A quasi-experimental research has been conducted in Samarinda senior high schools. This research was conducted in the odd semester of the 2017/2018 academic year. The purpose of this research was to determine the effectiveness of the Problem-Based Learning based learning materials and conventional based learning material, ethnic, and the interaction of Problem-Based Learning material, and conventional based learning material and ethnic on biology concept gaining. The samples of this research were the Natural Science students taken by using purposive sampling. The class XI Science 2 and XI science 6 of senior high school 2 were selected as the control group, and class XI Science 5 and XI Science 6 of senior high school 3 were selected as the experimental group. The instruments of this research were in the form of a questionnaire and a test. The data were analyzed using anova with 5% significance level ( $p < 0,05$ ). The results of anova analysis indicate that learning model had a significant effect on biology concept gaining; ethnic and the interaction between learning model and ethnic did not have a significant effect on biology concept gaining. The senior high school biology teachers are advised to prepare and implement Problem-Based Learning based learning materials more frequently to empower the students biology concept gaining. Further similar research are necessary to obtain more information.

**Keywords**— *learning material, Problem-Based Learning, conventional, biology concept gaining, multiethnic students.*

## I. INTRODUCTION

The teaching of Biology learning material in senior high schools need to pay attention to various affective aspects. These aspects might be internal and external aspects. The external aspects (learning strategies, curriculum, teacher, school, other students/ethnic students) are from the outside of the students. While the internal aspects (learning motivation, student physical condition, student psychology, students' ethnic, and others) are from within students.

The learning strategy factor is an external factor of learning; while the students' ethnic is the external factor as well internal factor. Both of these aspects should be taken into considerations by teachers in developing biology learning materials.

Boleng [1] explains that in a survey research conducted to 2.010 students class XI Natural Science of senior high schools in Samarinda about the students' ethnicity of students, there were four major ethnic groups, namely: Java (38,4%), Bugis (12.7%), Kutai (6.9%), Banjar (13.3%), and other ethnicities (28.54%). The diversity of students' ethnics is present in various senior high schools in Samarinda.

Related to the biology concept gaining of class XI senior high school students in Samarinda, the results of the survey conducted by Boleng showed that 6 biology teachers (20%) said that the average of the students' biology concept gaining was good (80- 100), 12 biology teachers (40%) said that the average of the students biology concept gaining was sufficient (60-79), and the remaining 12 biology teachers (40%) said that the students' biology concept gaining was  $< 60$ . [1]

The survey results of national examination for senior high schools in biology subject at Education Department of East Kalimantan Province showed that there was an increase in the average value of biology concept gaining, but it was still very small, for the last academic three years [2]. The average scores of the students biology concept gaining in the senior high schools in Samarinda city for the last three years in the academic year of 2013/2014, 2014/2015, 2015/2016 were: 4.73; 50.79; 54,57 [2]. The Biology concepts in senior high school include tissue and motion systems, which, according to the curriculum of 2013, are discussed in the odd semester of science class. The learning material about tissue discusses about the definition of tissues, types and functions of tissues both in plants and in animals. Motion system includes: bones, joints, muscles, and diseases and disorders in the motion system. The learning materials of tissues and motion systems are appropriate to be learned by following the patterns of PBL in the class because the activity of studying tissues can done in the classroom, and outside the classroom (homework). Likewise, the motion system can be learned by using the tools in the classroom, and can be expanded with the learning activities outside the classroom. This pattern of work allows students to better understand the phenomena that arise both in class and outside the classroom without having to use complex and expensive learning facilities. The learning of tissues and

motion system by implementing Problem-Based Learning (PBL) empowers concept gaining.

In addition to learning results, the results of the survey (in July 2016) to 30 senior high school biology teachers, show that 24 senior high school biology teachers know about PBL, 15 Biology teachers (62,5%) know the syntaxs of PBL learning, while the remaining 9 biology teachers (37,5%) do not know the syntaxs of PBL. From the 15 biology teachers who know the syntaxs of PBL, seven biology teachers (46,8%) are able to explain the syntaxs of PBL. While the remaining 8 biology teachers (53%) are not able to explain the syntaxs of PBL learning syntaxs.

The research results by Boleng in addition to eliciting information about the students' ethnicity, biology concept gaining, senior high school biology teachers' understanding on PBL, have also produced a learning material which implements PBL with biology learning material [1]. The implementation of the learning material was done in the senior high school with multiethnic students majoring in science in the odd semester 2017/2018 academic year in Samarinda.

The problems of this research were formulated as follows: (1) does the learning material applying PBL with biology learning material have an effect to the biology concept gaining of multiethnic senior high school students in Samarinda?, (2) does ethnic have an effect to the biology concept gaining of multiethnic senior high school students in Samarinda?, (3) does the interaction of the learning material applying PBL with biology learning material and ethnic has an effect to the biology concept gaining of multiethnic senior high school students in Samarinda?

This research has some contribution: (1) the senior high school biology teachers should be able to select and implements scientific approach based learning, such as PBL, as an effort to empower the biology concept gaining of multiethnic students, (2) the schools should provide facilities and infrastructure that support the implementation of scientific approach based learning, such as PBL with the biology learning materials in schools having multiethnic students, (3) the Education Department of East Kalimantan Province should facilitate the conduct of training/workshop of scientific approach based learning, for example PBL, to support the implementation of the curriculum 2013, to empower the biology concept gaining of multiethnic senior high school students in Samarinda.

## II. METHODS

This research used a quasi-experimental method. There were two independent variables in this research, namely the implementation of PBL material and conventional based learning material, and students' ethnicity; and one dependent variable, which was the students' biology concept gaining. The research design used was nonequivalent pretest-posttest control group. This research was conducted during odd semester in academic year of 2016/2017. Therefore, the learning materials used in this research were the biology learning material discussed in odd semester of the 2016/2017 academic year, which was about the tissues and the motion system. The data were collected in two stages: (1) stage survey stage was to know

the students' ethnic, and the score of the national examination of junior high school students, conducted for one month; (2) the treatment stage during the learning process in the classroom, conducted for eight weeks (two months).

The biology learning material discussed in the treatment stage was about: (1) the structure and the function of tissue making cells in plants and animals; consisting of: the structure and the function of tissue in plants, and the structure and the function of tissue in animals (3 weeks X 4 hour meeting); (2) the structure and function of tissue making cell in the motion system; which consists of the structure and the function of bones, muscles, and joints in humans (3 weeks x 4 hour meeting). The research was carried out in both public and private senior high schools in Samarinda. The schools which were used as the location of this research had several criteria as follows: (1) having a science major, (2) having students with various ethnic backgrounds (multicultural), (3) having statistically equivalent classes either in the same school or different schools.

This resarch used class XI Science students of senior high school in the odd semester in the 2016/2017 academic year as the population in Samarinda. The research samples were determined by using purposive sampling, both in the experimental group and the control group. The criteria for determining the research sample were: (1) the students were still in class XI science in the 2016/2017 academic year, (2) the students should attend the entire meetings in the classroom which implement the PBL learning model and conventional learning model, (3) the students have the ethnic background involved in this resarch. The classes chosen, either for the experimental class or for the control class, were based on the statistical placement test, by using the data from the national exam of Junior High School students. The number of classes required for this quasi experimental research was four classes (two classes for experimental class and two classes for the control class). The experimental class and the control class were randomly determined (if the results of the placement test obtained more than four classes), and not randomly determined if the results of the placement obtained only four classes. Before the treatment was given, both the experimental class and the control class were given a pretest. And after the treatment was given, both the experimental class and the control class were given a posttest, using the same test items with those in the pretest.

The test items developed for the pretest and posttest referred to the indicators of the students' critical thinking skills (formulating problems, giving arguments, making deduction, making induction, evaluating, deciding and executing), and the level of the students' biology cognitive achievement in the revised taxonomy Bloom (remembering, explaining, applying, analyzing, evaluating, and creating). The results of the pretest and posttest were corrected by using a scoring rubric of students' biology concept gaining, developed by referring to Hart [3]. Each test item was corrected using the scoring rubric, for the students' biology concept gaining.

The data were collected using two types of instruments, namely, (1) a questionnaire, which was used to collect the

information about the students' ethnic background in the odd semester of the 2016/2017 academic year, (2) the test items, which were used to measure the students' biology concept gaining. The test items were in the form of essay tests.

The research consists of 7 stages, namely: (1) conducting a survey to senior high schools that have science majors in Samarinda, to reveal the data about: the ethnic of the class XI science senior high school students, the score of the national examinaion of the junior high school students, the learning process in the classroom, (2) conducting placement test based on the students' ethnicity and the score of the national examination of senoir high school students, (3) determining the class XI Science of senior high schools as the experimental class and as the control class, which was based on the results of the placement test using statistical analysis. The number of classes required for this research was four classes, namely: two classes for the experimental class, and two classes for the control class. The classes for this research can be from one school or from different schools, (4) implementing a pretest before the treatment was given, both in the experimental class and the control class, (5) giving the treatment by implementing PBL material for the experimental class, and conventional based learning material for the control class, for eight weeks (two months), (6) after the treatment, both in the experimental class and in the control class, a posttest was given, and (7) analyzing the data of the results of the treatment in the class.

To know the variation of the students' ethnicity, the data of the survey results were analyzed using descriptive statistic analysis technique. Furthermore, to know the effect of the implementation of PBL and conventional learning, and students' ethnicity on the students' biology concept gaining, the ancova test with significance level of 5% ( $p < 0,05$ ) was performed.

### III. RESULT AND DISCUSSION

#### a. *The effect of PBL on biology concept gaining*

The ethnics of the class XI science students of senior high school in Samarinda can be seen in Table 1 below.

TABLE 1. DISTRIBUTION OF THE CLASS XI SCIENCE STUDENTS OF SENIOR HIGH SCHOOLS IN SAMARINDA BY ETHNICITY

No.	Ethnicity	N	Percentage (%)
1	Kutai	130	7
2	Banjar	297	16
3	Bugis	245	13
4	Java	721	38
5	Other Ethnicity	507	26
	Total	1.900	100

The classes used in this quasi experiment was: class XI science 2 and class XI science 6 in Senior High school 2 (control class); class XI science 5 and XI science 6 in senoir high school 3 (experimental class). The students' ethnics involved in this researchwere: Kutai, Banjar, Bugis, and Java. The results of Anova on the students'

Biology concept gaining show that the implementation of PBL and conventional based learning had an effect on the students' biology concept gaining. This information suggests that the learning syntaxs which were implemented in accordance with the prepared learning material provide the students with a different learning experience from the students who learned by using conventional learning material.

The implementation of PBL enables the students to search and find data. The required data were then processed to solve the formulated problems. Therefore, the implementation of PBL learning model produces a higher average score than the conventional learning model. El-Shaer et al. [4] concluded on his research results that the use of PBL in the experimental class statistically increased the mean score of the students' learning results and retention than that of the control class. Arnyana [5] and Marnoko [6] added that conventional learning is often identical with lectures. A lecture is an oral explanation from the lecturer to the students, providing information in words which is often obscure and sometimes misunderstood. Palenari [7] in his research concluded that the implementation of PBL integrated with cooperative learning Jigsaw had a significant effect on the concept gaining of different academic ability students, so that the integration of PBL+Jigsaw was more potential in improving the students' biology concept gaining. Therefore, it is suggested that biology teachers design and implement PBL learning more frequently. However, during the implementation in the classroom, teachers need to guide students in each step of PBL learning. Yamin [8] explains that a person who is unfamiliar with problem solving will be clumsy and confused, and have a weak mentality that ultimately cannot achieve the expected learning results.

The data collected by the students were the selected data, related to the problem solving efforts in biology learning in the classroom. The more data the students obtained related to the Biology learning material to be discussed (tissues and motion system), the more likely that they understand the concept of tissues and motion system. The information found and collected by the students will strengthen their understanding of the tissues and motion system learning material. Hartati et al. [9] explain that the syntaxs of the scientific method facilitate students to investigate a process, similar to scientists discovering science. Such learning process can empower the students' science process skills, self-esteem, thinking ability, understanding, and learning results. Yamin [10] adds that in the constructivist based learning process, the students build their understanding through active involvement in the learning process. Each students' experience has a correlation with their real life. Therefore, the learning activities should be real life atmosphere and real environment.

The concepts of tissues and motion systems can be learned by experiencing the learning process which implements the syntaxs of PBL learning, starting from formulating problems, collecting data, analyzing and discussing data, making inferences, and sharing and getting feedback from other students in the class. Such learning stages enable students to understand problems and



attempt to solve the problems related to the learning material, such as: tissues (the definition of tissues, the types and functions of tissues in plants and in animals); motion system (bones, joints, muscles, and abnormalities in the motion system). The students were given the opportunity to collect data related to the formulated problems on the tissues and motion system. Furthermore, the students were also given the opportunity to discuss the collected data to strengthen their understanding through scientific study from various scientific sources (books, journals, etc.) related to tissues and motion system, the stage of discussing data. Such learning patterns enable the students to understand the concepts of tissues and motion system better. Veselinovska [11] explains that in science learning, students use laboratory experiments or slide demonstrations at the beginning of the lesson to attract the students' attention and motivation. However using oral explanation might not attract the students' attention to learning material. The students' understanding can be increased by starting the lesson with an experiment, because it promotes the students' interest to the topics discussed.

*b. The Effect of ethnicity on biology concept gaining*

The results of Anova on the students' critical thinking skills indicated that students' ethnic does not have a significant effect on the biology concept gaining. This condition indicates that the character of the four ethnic groups was not significantly different in affecting the students' critical thinking skills. Yusof [12] explains that social interaction can be influenced by several factors, such as ethnicity, gender, and social class. Generally, ethnicity plays a very big role because it regulates the environment which is perceived to provide the foundation for what is true and what cannot be denied. Abruquah [13] adds that ethnic assimilation and ethnic succession have a similar character. Therefore, the students from various ethnic backgrounds, because they cooperate, learn to understand the character of other ethnic groups, have the same learning objectives, so that the "fusion" of characters from various ethnic groups, which is not generating a new ethnic, without losing the students' origin identity (ethnicity). Sonhadji [14] explains the view of *the salad bowl*, that is, every individual or group respectively shows a unique identity. This view rejects the idea of *a melting pot* or amalgamation, that is, the amalgamation of ethnicity and culture into a new nation, so that the characteristics of ethnicity and cultures that make up the unity of this nation are lost. Maaruf [15] in his research expects that the curriculum should deal specifically with one ethnic group and should not also be designed to provide a focus on the dominant ethnicity.

This information indicates that the students' ethnic differences in the study do not have an effect on the students' biology concept gaining. The students of a particular ethnicity adapt to other ethnicities in a multiethnic atmosphere in the classroom. Thus, each ethnic mutually strengthens each other, so that their biology concept gaining shows the similar results. Sonhadji [14] explains that it was found the philosophy of life of each ethnic in East Kalimantan, such as Java ethnic are "*mikul dhuwur mendem jero*" and "*alon-alon klakon*" [the highlights and deep inside, and slowly], Bugis ethnics are

"*kita orang harus pemberani*" [we must be brave], and Banjar ethnics are: "*pergi haji menaikkan status keluarga*" [going haji raises family status]. This philosophy of life of these ethnicities can be learned by the other ethnic students because they often work together in the classroom. Furthermore, it was emphasized that the students should be polite to anyone, they should be able to learn and cooperate with anyone, and they should obey school regulations. Priahrtini, et al. [16] explain that in some multiethnic countries, there is a symptom of separatism rooted in the primordial feelings of other ethnic groups. This can be seen from the lack of effective interaction among groups. Therefore, various strategies and approaches required to eliminate the prejudices to build effective interactions among ethnic groups.

The characters of Kutai, Banjar, Bugis and Javanese ethnics included in this research had a significant effect the Biology concept gaining about tissues and motion systems. They work together, complement each other and strengthen their understanding on the concepts of tissues and motion systems. Thus, this condition allows all students from different ethnic groups included in this research to understand the learning material of tissues and motion systems.

*c. The effect of the interaction between PBL and ethnic on biology concept gaining*

In addition to containing the information about the effect of the implementation of *PBL* and conventional learning; ethnic; Table 2 above also shows the effect of the interaction between learning materials and ethnic on the students' biology concept gaining. Table 2 above indicates that the interaction between learning material and ethnic do not have a significant effect on the students' biology concept gaining.

Information about the single effect of the implementation of learning material shows that learning material has a significant effect on the students' biology concept gaining. The other information about the single effect of ethnic indicates that ethnic does not have a significant effect on the students' biology concept gaining. However, the results of the analysis on the interaction between *PBL* learning and all the students' ethnics show that it does not have a significant effect. Likewise, the interaction between the conventional learning and all the students' ethnics does not have a significant effect on the students' biology concept gaining.

The results of the LSD test on the students' biology concept gaining as shown in table 4 indicate that the interaction between the *PBL* learning material and all the students' ethnics (Kutai, Banjar, Bugis and Javanese) has the same effect, and all were higher than that of the interaction between the conventional learning and all the students' ethnics (Kutai, Banjar, Bugis, and Jawa). The information shows that the interaction of *PBL* learning and the interaction of the conventional learning with all the students' ethnics (Kutai, Banjar, Bugis, and Javanese) have different results.

The learning experience of the students from all ethnicities (Kutai, Banjar, Bugis, and Javanese) in the *PBL* learning process allows the students to learn together

according to the stages of PBL. The students interact with each other, help and strengthen their understanding of the tissues and the motion systems. Thus, it allows the students from all ethnic groups to have almost the same understanding, because they work in groups and are mutually strengthening their understanding on the tissues and motion systems. All the syntaxs in BPL learning allow the students to cooperate in groups, so that all students from all ethnic groups have equally better understanding on the concepts of tissues and motion system, compared to the students in the conventional learning.

The implementation of conventional learning allows the students from all ethnic groups to rely more on individual work, and tends to wait for the information from the teachers' explanation about the tissues and motion system. The learning experiences which implement the conventional learning allow all the students from all ethnicities to tend to be passive, wait information from teachers, lower their creativity to seek other information to better understand the concept of tissues and motion systems. With such learning conditions, the students tend to get almost the same information (as obtained from the teacher); and it less develops the students' ability in designing experiments and discussing data related to the learning material of tissues and motion system. Thus, the biology concept gaining of the students from all ethnicities tend to be the same.

#### IV. CONCLUSION

Based on the results, it can be concluded that (1) the implementation of PBL learning with biology materials has a significant effect on the Biology concept gaining of multiethnic senior high school students in Samarinda, (2) the students' ethnic do not have a significant effect on the biology concept gaining of multiethnic senior high school students in Samarinda, (3) the interaction of PBL learning material with biology material and ethnicity does not have a significant effect on the biology concept gaining of multiethnic senior high school students in Samarinda.

Related to the conclusion of this research, it is suggested that: (1) senior high school biology teachers prepare and implement PBL in classroom with biology learning materials, (2) schools should equip the learning facilities and instructional media (3) Education Department of East Kalimantan Province should facilitate the participation of teachers in seminars or training / workshop on the preparation of implementing PBL with biology learning material..

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