

The Effect of Problem Based Learning Model Nuanced Science Literacy Towards Junior High School Students' Natural Sciences Learning Competence in Environmental Pollution and Global Warming Learning Materials

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Abstract - Result of the observation conducted in grade VII of SMP Negeri 2 Siak Hulu showed that students' competences in cognitive, affective and psychomotor domains is still low. Therefore, one way to solve the problem is the use of problem based learning model nuanced science literacy in learning process. Purpose of the research was to know the effect of problem based learning model nuanced science literacy towards students' competencies. This research was a quasi experimental research. Population of the research was students of grade VII of SMP Negeri 2 Siak Hulu year 2017/2018. Samples were taken by using random sampling technique. As a result, the samples were students from class VII₄ as experimental class, which was treated by using problem based learning model nuanced science literacy and class VII₃ as control class, which was treated by using conventional learning model nuanced science literacy. Instruments used were tests for cognitive competence and observation sheets for affective and psychomotor competences. Data analysis used in the research was T-test for cognitive competence and *Mann Whitney U* test for affective and psychomotor competences. Result of the research showed that the scores of students' competences in experimental class is better than the scores of students' competences in control class in learning natural science (IPA).

Keywords - Problem Based Learning; Science Literacy; Learning Competences.

I. INTRODUCTION

A variety of efforts have been done to improve education quality, especially in science education. It is caused by in Indonesian education system, science education is the basic components which composes the education itself. One of government efforts to complete curriculum is renewing the refined School-Based Curriculum (KTSP) becomes The Curriculum 2013. Mulyasa (2013) stated that The Curriculum 2013 is more emphasized on character education, particularly in elementary level which become foundation to the next level.

Curriculum development is focused on the formation of students' competences and characters in the form of cognitive, affective and psychomotor combination. Purpose of The Curriculum 2013 is to increase students' intellectual competence, especially high level competence. Students are demanded to solve problems through high level thinking competence, while teachers are demanded to have competence in implementing and actualizing The Curriculum 2013 by using literacy strategy in learning process.

One of the purposes of literacy in learning process is to make students able to think critically and solve the problems. Thus, literacy in learning process will form students' characteristics and develop their skills.

Based on students' cognitive competence obtained from Natural Sciences (IPA) teacher in SMP Negeri 2 Siak Hulu, it is found that students' learning competence in cognitive aspect was still lower than the defined Minimum Criteria of Mastery Learning (KKM), which is 75. Students' average score of a test can be seen in table 1 below.

Table 1. Percentage of Students' Learning Outcome Completeness of Natural Sciences (IPA) Subject in grade VII year 2017/2018.

No	Class	N	Students' Average Scores
1	VII ₁	28	72,64
2	VII ₂	29	69,28
3	VII ₃	30	73,33
4	VII ₄	30	74,57

Source: Biology teacher of SMPN 2 Siak Hulu, Kampar Regency

Based on the explanation above, it is assumed that a cause of low ability in problem-solving in IPA subject is lack of knowledge about literacy strategy in learning process so that students' comprehension is still low. Beside that, learning process still uses teacher centered model and does not involve students in it. To handle this matter, it is necessary to create pleasant atmosphere in the learning process. Then, model applied in learning process is also needed to improve in order to make it more interesting for students.

One of learning models that is applicable is Problem Based Learning model. It can help students to cooperate in solving the problems and also motivate them in learning.

According to Barrows and Tamblyn (in Nazir, 2010), problem based learning is the learning which is produced from working process to comprehension or problem-solving. In addition, Woltering (in Inel and Gunay, 2013) stated that purpose of the model is to stimulate students to solve the realistic problems, to cooperate and to activate higher level of cognitive.

The problem presented in the problem based learning is a problem which is able to attract students' interest so that they do not feel bored while learning. According to Savin

and Howell (2004), the way to present interesting problems is as follow: 1) the presented problems are related to basic knowledge so that students feel enthusiastic to solve them, 2) the problems presented are related to real life situation in order to stimulate students' curiosity, 3) the problems are still in form of puzzles that have to be solved and 4) the problems are communicated interestingly.

Compiling the problem based learning model with science literacy will facilitate students in learning process. It is because problem based learning demands students to learn to solve the problems, while science literacy demands them to develop their creative ability, to solve not only individual problems but also meaningful scientific problems and to make responsible social-scientific decision. Beside that, students' background, interest, learning intensity, and attitudes factors towards sciences also influence the low of science literacy achievement. It is in line with Ardianto's (2016) research, which stated that problem based learning model can improve science literacy.

II. RESEARCH METHOD

This research used quasi experimental method. Experimental class was treated by using problem based learning model nuanced science literacy, while control class used Direct Instruction model nuanced science literacy. Design of the research used randomized control-group posttest only design.

A. Technique of Data Analysis

1. Normality Test

Normality test used was *Kolmogorov-Smirnov* test. The purpose of this test is to see whether population has normal distribution or not. Data distributed normally if the Sig. value > 0.05 with statistical hypothesis as follows:

H_0 = data are distributed normally

H_1 = data are not distributed normally

The testing criteria are H_0 is accepted if Sig. value > 0.05, which means data are distributed normally and H_0 is rejected if Sig. value < 0.05, which means data are not distributed normally.

2. Homogeneity Test

Homogeneity of variance test was done by using *Levene's* test. This test was conducted to know whether population has homogeneous variance or not. The test was conducted by assistance of SPSS 17 software. The testing criteria are H_0 is accepted if Sig. value > 0.05 and H_0 is rejected if Sig. value < 0.05.

B. Hypothesis Testing

Purpose of the hypothesis testing is to know whether Problem based learning nuanced science literacy influence students' learning competences. The testing criteria are if Sig. value > 0.05 , H_0 is accepted and H_1 is rejected, while if Sig. value < 0.05 , H_1 is accepted and H_0 is rejected.

1. First Hypothesis Testing

Statistical test done to first hypothesis was T- test because the data are distributed normally and the variance is homogeneous. If the data are distributed normally but the variance is not homogenous, the test which is done is *Mann-Whitney U* test. In this research, hypothesis testing was done by assistance of SPSS 17 software.

2. Second and Third Hypothesis Testing

Statistical test used for second and third hypothesis is *Mann-Whitney U* test because these hypotheses use ordinal data, in which the calculating result is not in form of decimal and the numeral used is only label of the data. The testing criteria are if Sig. value > 0.05 , H_0 is accepted, while if Sig. value < 0.05 , H_0 is rejected.

III. RESULT AND DISCUSSION

A. Result Of The Research

From the result of the data, it is found that normality test for basic competency (KD) 3.8 about environment pollution in the experimental class was 0.114 and in the control class was 0.200, which mean the data distribution was normal because Sig. value > 0.05 . Beside that, homogeneity test for KD 3.8, both experimental and control classes was 0.216, which mean it was homogenous because Sig. value > 0.05 . Meanwhile, for KD 3.9 about global warming, for experimental and control classes, Sig. value < 0.05 . Then, the test was continued but using *Mann Whitney U* test. The result showed that Sig. value Sig. value was 0.275, which means Sig. value > 0.05 . So, it can be concluded that there was no significant effect for homogeneity test to KD 3.9. However, when it was calculated by using average scores of both KD 3.8 and KD 3.9, the scores had normal and homogenous distribution, in which average score of experimental class treated by problem based learning model nuanced science literacy was 85.27 and average score of control class using direct instruction model nuanced science literacy was 78.87. For normality test, both experimental and control classes had normal distribution. Then, for homogeneity test, both experimental and control class had homogenous distribution.

1. Data Analysis

Test of Analysis Conditioning is conducted before doing hypothesis testing. The test which is done first is normality test by using *Kolmogorov-Smirnov* test. Second test is homogeneity of variance test by using *Levene's* test in assistance of SPSS 17 software. If data distribution is normal and homogenous, the hypothesis testing uses T-test. On the other hands, if data distribution is not normal, there is no homogeneity of variance test done and the hypothesis testing uses *Mann Whitney U* test.

a. Normality Test

The normality test was conducted by using *Kolmogorov-Smirnov* test by assistance of SPSS 17 software. The testing criteria are H_0 is accepted if Sig. value > 0.05 and H_0 is rejected if Sig. value < 0.05 . The calculation result showed that students' cognitive competence for both experimental and control classes has Sig. value 0.200, which means that the data were normal.

b. Homogeneity Test

The homogeneity test of students' final test score for both experimental and control classes used *Levene's* test, assisted by SPSS 17 software. The testing criteria are H_0 is accepted if Sig. value > 0.05 and H_0 is rejected if Sig. value < 0.05 . From calculation result, it showed that students' cognitive competence for both experimental and control classes has Sig. value 0.108, which means that the data were homogenous.

2. Hypothesis Testing

a. First Hypothesis

The first hypothesis testing was used to know students' cognitive competence. The result showed that students' cognitive competence in experimental class which was treated by using problem based learning model nuanced science literacy was better than students' cognitive competence in control class which used Direct Instruction learning model nuanced science literacy. Because the data are distributed normally and they have homogenous variance, the test used was T-test.

The result showed that students' cognitive competence has Sig. value 0.013. It means that H_0 was rejected. The result of hypothesis testing of students' cognitive domain competence is presented in Table 2.

Table 2. The Result of Hypothesis Testing of Cognitive Domain Competence

Class	Sig	α	Conclusion
Experiment	0,013	0,05	H_0 is rejected
Control			

From the result presented in table 2 above, it can be concluded that there was a significant effect of using problem based learning model nuanced science literacy towards students' cognitive domain competence. It means that cognitive domain competence of students who were treated by using problem based learning model nuanced science literacy is better than the cognitive domain competence of students who were treated by using Direct Instruction model nuanced science literacy.

b. Second Hypothesis

This hypothesis testing was used to know the effect of problem based learning nuanced science literacy towards students' affective domain competence. Students who were treated by using problem based learning model nuanced science literacy has better affective competence than students who were treated by using Direct Instruction model nuanced science literacy. It was known from the result of *Mann Whitney U* test.

The result showed that students' affective competence has Sig. value 0.000. It means that H_0 was rejected. The result of hypothesis testing of students' affective domain competence can be seen in Table 3.

Table 3. Result of Hypothesis Testing of Students' Affective Domain Competence

Class	Sig	α	Conclusion
Experiment	0,000	0,05	H_0 is rejected
Control			

From the Table 3 above, it can be concluded that there was a significant effect of problem based learning model nuanced science literacy towards students' affective domain competence. It means that the affective domain competence of students who were treated by using problem based learning model nuanced science literacy is better than the affective domain competence of students who were treated by using Direct Instruction model nuanced science literacy.

c. Third Hypothesis

This hypothesis testing was used to know the effect of problem based learning nuanced science literacy towards students' psychomotor domain competence. Students who were treated by using problem based learning model nuanced science literacy has better psychomotor competence than students who were treated by using Direct Instruction model nuanced science literacy. It was known from the result of *Mann Whitney U* test.

The result showed that students' psychomotor competence has Sig. value 0.000. It means that H_0 was rejected. The result of hypothesis testing of students' psychomotor domain competence can be seen in Table 4.

Table 4. Result of Hypothesis Testing of Students' Psychomotor Domain Competence

Class	Sig	α	Conclusion
Experiment	0,000	0,05	H_0 is rejected
Control			

From the Table 4 above, it can be concluded that there was a significant effect of problem based learning model nuanced science literacy towards students' psychomotor domain competence. It means that the psychomotor domain competence of students who were treated by using problem based learning model nuanced science literacy is better than the psychomotor domain competence of students who were treated by using Direct Instruction model nuanced science literacy.

B. Discussion

The problem based learning model nuanced science literacy is expected to make students involve actively in learning process and enable them to improve their competences. Based on the result of the research, it shows that students' cognitive domain competence can increase by using problem based learning model nuanced science literacy. This learning model can give effects towards students' cognitive domain competence, in which the average score of students from experimental class is 77.33 and from control class is 70.87. From the students' average scores, it is obvious that the scores are different between two sample classes. It might be caused by problem based learning model is the learning model which presents contextual problems.

The problem based learning model nuanced science literacy is believed to increase students' learning competences because this model has important role to help students map comprehension process towards texts or information by using graphic controller or science literacy aids. Moreover, it is believed to train students in doing works together and sharing mind in learning process so that they can understand the learning materials easier. It is in line with Hmelo-Silver (2004), who stated that in problem based learning model, students cooperate in small group and learn what they need to know to overcome the problems.

Learning activities by using the problem based learning model have five main stages which are initiated by introducing the problems to students and ended by serving students' works. These five stages are orienting students to the problems, organizing students to learn, guiding individual or group investigations, developing and serving students' works, and analyzing and evaluating problem-solving process.

In the orienting students to the problem stage, they are asked to understand the problems provided in problems sheets. Activity done by students is to find problems in the sheets. Then, they try to solve the problems together and share their opinion about their experiences related to the problems through teacher's explanation.

According to Yeung and Ram (in Bilgin, et al., 2009), in the problem based learning model, students are not only able to get basic knowledge while learning, but also able to experience how to use knowledge to solve their problems in the real world. After that, students are brave to give complete explanation to respond inaccurate answers. Giving the real problems will stimulate their curiosity and desire to observe the problems.

In the guiding individual or group investigations stage, there are some graphic controller or science literacy aids, like cause-effect and problem-solving. Teacher guides and gives instruction to students to discuss in solving the problems. This stage can improve students' thinking ability. It is caused by teacher asks students to discuss the most appropriate strategy in solving the provided problems and then to find information about causes and effects of the problems.

After students find alternative solution that is used to solve the problems, they try to do investigation in groups in order to find the most appropriate solution for the problems. In this stage, they are also asked to draw conclusion from problem solving activities that is conducted. The next stage

is students are asked to develop and present their work. Teacher asks some groups to present their works in front of the classroom, while other groups are asked to respond or give suggestions to the groups which present their work.

Based on these stages, it is obvious that students actively participate in learning process, do collaborative works, and the learning process is centered on them. It is showed that problem based learning model can push students to think in solving the problems. It is in line with Masek and Yamin (2011), who stated that the stages of problem based learning model are able to support students' cognitive competence.

Affective and psychomotor assessments are to support learning process that is done. Based on the observation result of students' affective and psychomotor domain competences, it shows that data of the students' affective and psychomotor domain competences in experimental class are better than data of the students' affective and psychomotor domain competences in control class.

According to Saleem et al. (2014), problem based learning model enables students to develop their autonomous learning skills and to have responsibility to learn individually. Sluijsmans et al. (2001) also stated that in problem based learning model, students work in group and each member of group is responsible for specific part of the tasks given.

Furthermore, Arends (2008) also said that problem based learning model can help students develop their cognitive competence and problem-solving skills, be autonomous learners, and train them to develop and investigate the problems by increasing their consciousness about the different way in thinking to solve the problems. Sockalingam et al. (2011) also had opinion about the improvement of problem-solving ability and students' cognitive learning outcomes through problem based learning model is also inferred because this model is based on the principles that students not only get knowledge but also they know how to implement their knowledge in real situation.

IV. CONCLUSION

Based on the result of the research and data analysis, it can be concluded that there is a significant effect of implementing problem based learning nuanced science literacy in improving students' cognitive, affective and psychomotor domain competences in learning IPA. Students who were treated by using problem based learning model nuanced science literacy have better cognitive, affective and

psychomotor domain learning competence than students who were given direct instruction model nuanced science literacy.

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REFERENCES

- [1] Arends, R. 2008. *Learning to Teach*. Translator: Helly Prajitno & Sri Mulyani. New York: McGraw Hill Company.
- [2] Ardianto, D and Rubini, B. 2016. Comparison Of Students' Scientific Literacy In Integrated Science Learning Through Model Of Guided Discovery And Problem Based Learning. *Jurnal Pendidikan IPA Indonesia*. 5 (1): 31-37.
- [3] Bilgin, S. Senocak, E and Sozbilir, M. 2009. The Effects of Problem-Based Learning Instruction on University Student's Performance of Conceptual and Quantitative Problem in Gas Concepts. *Eurasia Journal of Mathematics, Science & Technology Education*. 5 (2): 153-164.
- [4] Inel, D and Gunay, A. B. 2013. Concept Cartoons Assisted Problem Based Learning Method in Science and Technology Teaching and Students' Views. *Procedia - Social and Behavioral Sciences*. 93: 376-380.
- [5] Masek, A and Yamin, S. 2011. The Effect of Problem Based Learning on Critical Thinking Ability: A Theoretical and Empirical Review. *International Review of Social Sciences and Humanities*. 2 (1): 215-221.
- [6] Mulyasa. 2013. *Pengembangan dan Implementasi Kurikulum 2013*. Bandung: PT Remaja Rosda Karya.
- [7] Nazir, M. and Zabit, M. 2010. Problem-Based Learning on Students' Critical Thinking Skills in Teaching Business Education in Malaysia: A Literature Review. *American Journal of Business Education*. 3 (6).
- [8] Saleem, M. A., et al. 2014. The Effects of Problem-Based Learning on Self-Directed Learning Skills among Physics Undergraduates. *International Journal of Academic Research in Progressive Education and Development*. 3 (1).
- [9] Savin, M and Howell, C. 2004. *Foundations of Problem-Based Learning*. London: MPG Book Ltd.
- [10] Sluijsmans, D. M. A., et al. 2011. Peer Assessment in Problem-Based Learning. *Studies in Educational Evaluation*. 27: 151-173.
- [11] Sockalingam, N., et al. 2010. Student and Tutor Perceptions on Attributes of Effective Problems in Problem-Based Learning. *Higher Education*, 62(1), 1-16.