The Effect of Mind Mapping-Assisted Problem-Based Learning (PBL) Model on Science Process Skills of Fifth Graders

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Article Info

Abstract

Science learning model directs students to learn concept understanding and scientific principle. Scientific principle in science learning relate to investigation or experiment to drill science process skills that can develop critical thinking and problem-solving abilities. Process skills are students' abilities to manage what has been gained in teaching and learning activities. The purpose of this study was to analyze the effect of using the Mind Mapping, Problem Based Learning (PBL) model, and Problem Based Learning model assisted by Mind Mapping on students' science process skills. The research method used quantitative research in the form of quasi experimental design. The sample of this study were students of 5th grade with 30 students as experimental class, 24 students as control-1 class, and 28 students as control-2 class. The data collection techniques used in this study were written test, observation, and documentation. The results of the analysis showed that simultaneously a learning model affected students' science process skills by 13%. This study had also showed that of the three models that had been used, problem-based learning assisted by mind mapping model was the most effective model for improving students' science process skills compared to problem-based learning model or mind mapping model.

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INTRODUCTION

Learning refers to an interaction process that occurs among students, teachers and learning resources. It has purpose to develop dimension of attitude, knowledge, and skill through attitude change which seeks out various learning resources with a competency-based scientific approach (Kemdikbud, 2013: 1).

Learning process emphasizes the related interaction among student, teacher, method, curriculum, facility, and environmental aspect to achieve learning goals, one of them is student creativity (Aini, Mardiyani & Sari, 2015). Therefore, a learning process needs to use a model that can provide direct experience for students, particularly in science.

The model in science learning does not only manage students to learn the scientific concept and principle of science but also prioritizes the development of understanding and the concept of application. Through a series of science learnings, students will directly gain knowledge through activities such as observation, discussion, and investigation (Noviyanti, Rusdi & Ristanto, 2019).

The teacher must design a student-centered learning to encourage students learning enthusiasm, to motivate their creativity, initiative, innovation, and independence. However, based on the existing condition, most of science teachers still use lecture method in teaching this subject. The reason the teacher still uses this method is that it does not take much time in its application. In addition, the teacher often does not focus on student creativity (Sriwenda, Mulyani & Yamtinah, 2013). The use of lecture method by science teacher results student science process skills aspect (KPS) to be low. The learning process becomes less effective because it only focuses on the teacher, while students become inactive so that there is no learning experience which involves the environment and scientific work as a science literacy skill builder for students.

The monotonous learning process causes students feels uninterested in science. Rusmiyati & Yulianto (2009) explain that science education is closely related to scientific performance which can be evolved through hands-on or direct experience with investigation and experiment to train KPS to produce minds on knowledge. Seyhan (2015) states that the main purpose of science learning is to enable students to develop question, critical thinking, and problem-solving skill to become lifelong learner and keep having a sense of curiosity about their environment. Hence, it is important for students to acquire scientific process skills as well as learn about the nature of science through experience.

Sumarli, Nugroho, & Yulianto (2018) state that the low achievement of student scientific literacy is due to the lack of student KPS which includes classification, interpretation, and application of concept. In this study, the low level of student KPS is shown by the results of observation and interview of fifth grade teachers in elementary schools in the R.A Kartini cluster, Gembong District, Pati Regency. The results of observation and interview indicate that students are less interested in science because the teacher only uses the lecture method in delivering material.

Considering the importance of student KPS which can impact on student cognitive learning outcomes in science learning, a suitable learning model which is in accordance with the main objective of teaching science is needed to improve student process skills. One of the proper learning models for science is PBL. Hidayah & Pratiwi (2016) state that the learning process using the PBL model provides opportunity for students to learn through experience by conducting experiment. In terms of the role, the teacher's role is changed from being an informant into a facilitator in thinking, reflecting and collaborating on findings, while it is students who decide the problem (Damayanti, Sarwi, & Astuti, 2018).

The PBL model can be combined with other models, for example the Mind Mapping. Tenriawaru (2014) states that Mind Mapping is a technique to maximize brain function by integrating logic and imagination so that it can ease someone to organize and remember all forms of information both verbal and nonverbal. The use of Mind Mapping in learning activity is expected to be able to stimulate student critical thinking skill and creativity. From creativity, students can convey ideas, record what they have learned, or plan new works. Thus, based on the previous explanation, this study aims to determine the effect of Mind Mapping-assisted Problem-Based Learning (PBL) model in improving student KPS. This research is expected to be useful and becomes an alternative way to enhance student KPS so that students can have high creativity and imagination to increase their motivation in science learning.

METHOD

This research applied quantitative methods with a Quasy Design (quasi-experimental). The population in this study was fifth grade students at elementary schools in the R.A Kartini cluster, Gembong District, Pati Regency, which consists of 5 elementary schools. The research was conducted in semester 1 of the 2018/2019 academic year in which learning material was human respiratory organs. The samples were taken by using purposive sampling technique based on several considerations. These samples were fifth grade students of SDN Wonosekar with 30 students as the experimental class by using the PBL model assisted Mind Mapping, fifth grade students of SDN Samirejo 01 with 24 students as control class-1 by using Mind Mapping model and fifth grade students of SDN Samirejo 02 with 28 students as the control class-2 by using PBL model.

The data collection used test and non-test technique. The instrument of data collection was an observation sheet to measure student KPS. KPS measurement consists of 5

assessment aspects that are then described as 9 components of observation. Those components which are used including ability of solving problems presented (1), using more than one sensory tool (2), summarizing observation result (3), grouping (4), actively asking questions based on material (5), explaining the main basis of what has been done, observed, and found (6), presenting the findings (7), hypothesizing based on learning objectives (8), And drawing conclusions based on the findings (9).

Teaching and learning activities in this study were conducted in 3 meetings. In the first meeting, learning was out using conventional methods, that is the lecture method. The learning model treatment used in this study was applied after the second to the third meeting. Before being given the treatment, each group was analysed its similarity by using the homogeneity and normality test of the sample. After obtaining the similarity of the initial conditions of each group, the treatment was given to the experimental group by using the PBL model assisted by Mind Mapping. Meanwhile, the control class-1 was only given the Mind Mapping model treatment and the control class-2 was only given the treatment of PBL model. The quantitative data analysis technique used hypothesis testing. Hypothesis test analysis which was used to describe the effect of the learning model on student KPS was the paired sample test and ANOVA.

RESULTS AND DISCUSSIONS

The results of both pretest and posttest data of normality test of student KPS which used Kolmogorov-Smirnov in the control and experimental class had a sig. value more than alpha 0.05 meaning that the distribution of data was normal. While the results of the homogeneity test showed that the significance value of each students' KPS pretest and posttest data from the control and experimental class was more than 0.05 meaning that the data was homogeneous.

The Effect of Mind Mapping Model on Student KPS

The result of testing effect of the Mind Mapping learning model on student KPS using paired sample t-test on the pretest and posttest data obtained a t-count value of -2.521 and a sig. value (2-tailed) of 0.019. Since the sig. value of 0.019 was less than 0.05, it could be concluded that there was a significant difference between the average of pretest and posttest data of student KPS by using the Mind Mapping learning model.

The testing effect of the Mind Mapping learning model is also proven by descriptive statistic of the pretest and posttest data, which can be seen in Table 1.

Table 1. Descriptive Statistic of KPS by Using Mind Mapping Model

Descriptive Statistic	Pretest	Posttest
Average	19.63	20.92
Standard Deviation	04.12	04.25
Variance	16.94	18.08

Based on Table 1, the average of posttest data is 20.92, which is higher than the average of the pretest data, which is 19.63. Therefore, it shows that the Mind Mapping learning model has a significant influence on students' KPS improvement.

This is in line with the research which conducted by Mehakati (2017) showed that the use of the mind mapping learning model could improve learning outcomes in social subject in fifth grade students with a percentage of 79% of students who reach minimum completeness criteria (KKM) in cycle II. Astuti (2019) states that Mind Mapping is a learning technique which can develop creativity, activeness, memorization, knowledge, and independence of students in achieving learning goals. Thus, it indicates that the use of Mind Mapping learning model in this study can increase the average students' KPS by 1.29 or 3.59%.

The Effect of Problem Based Learning Model on Student KPS

The testing effect was also carried out to the control class 2 by providing the PBL model. The testing effect of the PBL model on student KPS using paired sample t-test on the pretest and posttest data obtained t-count values of -4.322 and sig. (2-tailed) by 0.00. Since the sig. value was less than 0.05, which indicated that there was a significant difference between the average of pretest and posttest data of student KPS by using the PBL model.

The testing effect of the PBL model is also proven by the descriptive statistics of the pretest and posttest data, which can be seen in Table 2.

Table 2. Descriptive Statistic of Student KPS by Using Problem Based Learning Model

Descriptive Statistic	Pretest	Posttest
Average	21.464	22.714
Standard Deviation	04.765	04.689
Variance	22.702	21.989

It can be seen from the Table 2 that the average of posttest data is 22.714, which is higher than the average of pretest data, which is 21.464. In conclusion, the PBL model gives influence in improving student KPS.

This is in accordance with a research conducted by Hardiyanti, Wardani & Nurhayati (2017) which showed that the use of the PBL model could increase student KPS N-Gain by 0.71 with high criteria. Wirda, Haji & Khaldun (2015) also stated that student KPS in the material of optical equipment also increased with the average from 5.56 to 13.40 with an increasement in N-Gain of 0.63 by applying PBL model. From those previous studies, Bashith & Saiful (2017) suggest that the PBL should be an alternative teaching model which can be applied to enhance student critical thinking skill. Thus, in this study it is proven that the use of the PBL model can rise the students' KPS average by 1.25 or 3.47%.

The Effect of Mind Mapping-Assisted *Problem Based Learning* (PBL) on Student KPS

Beside to the control class 1 and 2, the testing effect was also conducted to the

experimental class to determine the effect of the Mind Mapping-assisted PBL model on student KPS. The result of the test by using paired sample t-test on the pretest and posttest data obtained t-count values of -11.969 and sig. (2-tailed) by 0.00. Since the sig value of 0.00 was less than 0.05, it could be concluded that there was a significant difference between the average of pretest and posttest data of student KPS taught by using the PBL model assisted by Mind Mapping. This difference can be proven by the descriptive statistics of the data in Table 3.

Table 3. Descriptive Statistic of student KPS by Using Problem Based Learning Assisted by Mind Mapping

Descriptive Statistic	Pretest	Posttest
Average	20.90	27.133
Standard Deviation	05.01	04.826
Variance	25.06	23.292

It can be seen from the Table 3, the average of posttest data is 27.133, which is higher than the pretest data, which is 20.9 meaning that the Mind Mapping-assisted PBL model has influence in improving student KPS.

Student KPS can be improved by a strong understanding of concept and problem-solving activities. This is related to a research conducted by Astuti (2019) which states that the PBL model assisted by Mind Mapping makes problem-solving activities become directed and efficient. Furthermore, according to Efwinda & Sopandi (2016), student mastery of concept can be strengthened by the help of Mind Map in problem-based learning compared to student mastery of concepts without the help of a Mind Mapping.

The use of the PBL model assisted by Mind Mapping can stimulate students to take an active role in investigating authentic problems (Novita, Bukit & Sirait, 2019). Thus, the PBL model assisted by Mind Mapping can deepen student knowledge in understanding existing problems and finding out solutions to the

problems which are being faced. Therefore, it is proven that the use of the PBL model in this study can increase students' KPS average by 6.233 or 17.31%.

Comparison Test of Learning Model on Student KPS

After obtaining the results showing that the three learning models influence student KPS, it was necessary to do a two-way ANOVA test to find out how much the three learning models influence student KPS. The results of the two-way ANOVA test are shown in Table 4.

Table 4. The Result of Two-Way ANOVA Test on Student KPS

Source	F	Sig.	Explanation
Corrected Model	5.89	0.004	Significant
Intercept	2064.93	0.000	Significant
Model	5.89	0.004	Significant
Error			
Total			
Corrected Total			
R Squared = 0.130 (Adjusted R Squared = 0.108)			

Based on Table 4, the sig. value in the corrected model is 0.004. Since 0.004 is less than 0.05, it means that there is a significant influence on student KPS by giving the three types of learning models. In Table 4, it is also know that the R Squared value is 0.130, meaning that there is an effect on giving the three learning models on student KPS by 13%.

After knowing that there was an influence of the three learning models on student KPS, a comparison test was continued with one-way ANOVA analysis to see which was the best one of the three models in improving student KPS.

From the results of the one-way ANOVA test, the sig. value obtained 0.004 and F-count of 5.892. Since 0.004 was less than 0.05, it indicated that there was a significant difference between the average of student KPS in the control and the experimental class.

Because there were differences in the average of the three given learning models, a

post-hoc LSD further test was done as in Table 5.

Table 5. The Result of Further Post Hoc LSD test

Model	Sig	Explanation
Mind Mapping vs PBL	0.179	Insignificant
Mind Mapping vs PBL & Mind Mapping	0.001	Significant
PBL vs PBL & Mind Mapping	0.040	Significant

Table 5 shows that from those three learning models, the one which is significant (there is a difference in the average) to student KPS is the Mind Mapping learning model with the PBL assisted by Mind Mapping and the PBL model with PBL model assisted by Mind Mapping. Because there is a significant difference between those two significant models, to see which is the best learning model can be seen from the average value of the descriptive statistical in Figure 1.
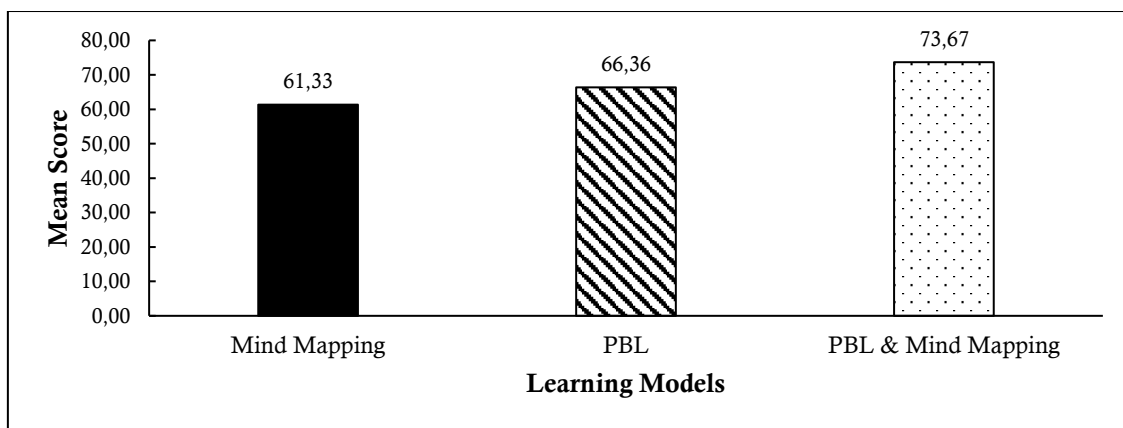

Figure 1. Score Total of the Students' KPS

Figure 1 shows that the average of student KPS using PBL model with Mind Mapping is 73.67, which is higher than the average student KPS using the Mind Mapping and PBL model.

Based on the average of student KPS in each learning model in this study, it can be concluded that the PBL model assisted by Mind Mapping is more effective to improve student KPS.

In the 3rd meeting, the student's KPS measurement which is shown in Figure 2 explains that from those three learning models, the average of KPS score in the experimental class is higher than the control class 1 and control class 2 on each indicator. The most prominent indicator in improving students' KPS

score is indicator 1, which is ability of solving problems presented with an average score of 3.23 with a percentage of 80.8%. The graph of students' KPS average score on each indicator is presented in Figure 2. The indicators used consist of indicators 1 to 9 as previously explained, that is consisting by ability of solving problems presented (1), using more than one sensory tool (2), summarizing observation result (3), grouping (4), actively asking questions based on material (5), explaining the main basis of what has been done, observed, and found (6), presenting the findings (7), hypothesizing based on learning objectives (8), And drawing conclusions based on the findings (9).
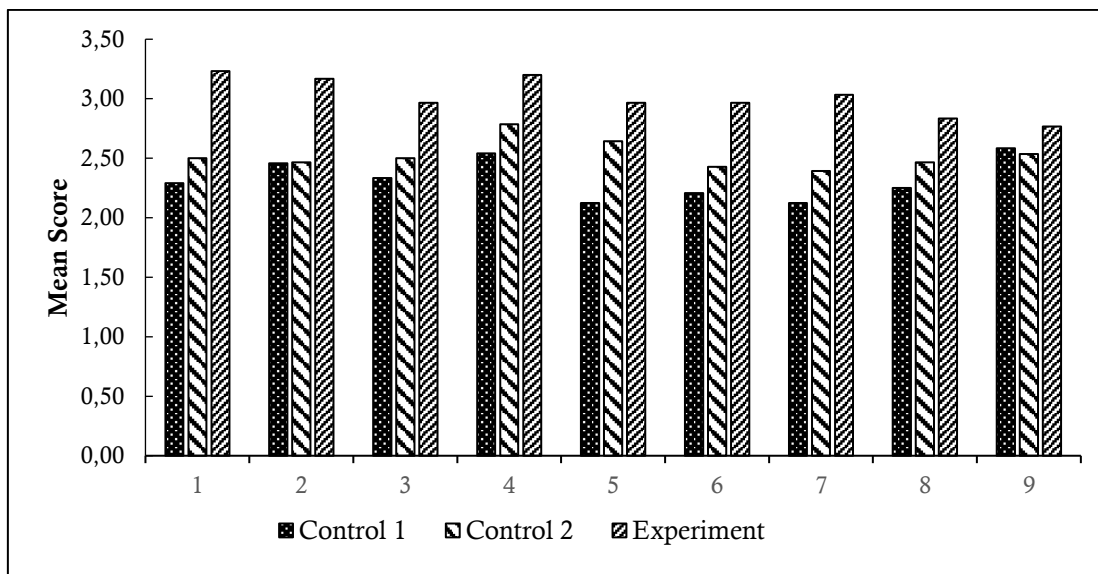
Figure 2. Comparation Mean Score KPS for each Indicator

The essence of biology education (IPA) as a science does not only develop aspects of knowledge, but also the process of skills and attitudes. Rillero (in Aydoğdu, Erkol & Erten, 2014) emphasizes that individuals who cannot use the science proses skill will experience difficulties in daily life. This indicates that KPS is indispensable to be developed and owned by every elementary school student.

Based on the research findings, the use of Mind Mapping-assisted PBL model can enhance students' KPS results. In addition, it is more efficient to improve student KPS compared to previous studies which only applied the PBL method and the Mind Mapping learning method only. Furthermore, in previous studies, the comparison of PBL model assisted by Mind Mapping was only conducted to one control class by using the lecture method. Whereas in this study the comparison was done to 2 control classes where each control class only applied one of the models, namely PBL only or Mind Mapping only.

Prasetiya (2018) states that the use of PBL model assisted by Mind Mapping is more effective to be applied in a learning rather than the lecture method because it can increase student understanding and help them to develop thinking and problem solving skill. Ula (2019) adds that using the Mind Mapping-assisted PBL

model effectively improves student critical thinking skill and affects student learning outcome in cognitive and psychomotor as well as student better attitude (Asiah, Sudarti & Lesmono 2016).

CONCLUSION

Based on the results and discussion of the research, it can be drawn the conclusion that students who get PBL method assisted by Mind Mapping can improve their science learning process skill particularly in the human respiratory organs material. The increasement of student KPS using the PBL model assisted by Mind Mapping is 17.31% higher than the increasement of student KPS with the PBL model which is 3.47% and the mind mapping model is 3.59%.

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