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Implementation of Project Based Learning Model for Enhancing Students' Practical Skill and Scientific Literacy

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Abstract: Implementation of Project Based Learning Model for Enhancing Students' Practical Skill and Scientific Literacy. Objectives: This study is aimed to determine the difference of implementation between project based learning and direct instruction model in chemistry teaching of acid and base matter to enhancing students' practical skill and scientific literacy. **Methods:** The sampling technique was purposive sampling that obtained class XI MIPA 1 as an experimental class was taught using project based learning model, while XI MIPA 2 as a control class was taught using direct instruction model. The instruments of data collecting are test and non test. The test by using the form of a description was used to measure students' scientific literacy, while non test by using the observation sheet was used to measure students' practical skill. The data analysis used manova test at significance level of 5%. **Findings:** The results showed that the Hotelling's Trace value on the manova test had a significance of 0.000. **Conclusion:** there is a significant difference between implementation of project based learning and direct instruction model in chemistry teaching of acid and base matter for enhancing students' practical skill and scientific literacy wholly and partially.

Keywords: project based learning, practical skill, scientific literacy

***Abstrak: Penerapan Model Project Based Learning Materi Asam dan Basa terhadap Practical Skill dan Literasi Sains Peserta Didik*. Tujuan:** *Penelitian ini bertujuan untuk menguji perbedaan penerapan model project based learning dengan model direct instruction pada pembelajaran kimia materi asam dan basa terhadap practical skill dan literasi sains peserta didik kelas XI.* **Metode**: *Pengambilan sampel dilakukan dengan purposive sampling sehingga diperoleh kelas XI MIPA 1 sebagai kelas eksperimen diterapkan pembelajaran menggunakan model project based learning, sedangkan kelas XI MIPA 2 sebagai kelas kontrol diterapkan pembelajaran menggunakan model direct instruction. Instrumen pengumpulan data menggunakan tes dan nontes. Tes yang berupa soal uraian digunakan untuk mengukur literasi sains peserta didik. Nontes yang berupa lembar observasi digunakan untuk mengukur practical skill peserta didik. Analisis data menggunakan uji Manova dengan taraf signifikansi 5%.* ***Temuan**: Hasil penelitian menunjukkan nilai Hotelling's Trace pada uji manova memiliki signifikansi 0,000.* ***Kesimpulan:** terdapat perbedaan yang signifikan antara penerapan model project based learning dengan model direct instruction pada pembelajaran kimia materi asam dan basa terhadap practical skill dan literasi sains peserta didik baik secara keseluruhan maupun parsial.*

***Kata Kunci:** project based learning, practical skill, literasi sains*

▪ INTRODUCTION

Education plays very important roles in preparing the quality of human resources and has to be responsive to the progress of the 21st century development. As established by UNESCO (Sani, 2014: 8), the 21st century competencies include: (1) creativity and innovation; (2) critical thinking and problem solving skills; (3) communication and collaboration; (4) social and cross-cultural skills; and (5) control of information. The quality of human resources heavily rely on educational synergy. Therefore, there is a need to improve the quality of various educational components, one of which is the curriculum improvement and development. The current 2013 curriculum aims to develop students' attitudes, knowledge, and skills in various situations within society. In fact, chemistry learning at schools mostly still focus more on the aspect of product and tends to rule out the aspects of process and attitude. Teachers give more theory only, so students just do memorizing without mastering the concept. This condition causes students tend to be passive, so they cannot develop their thinking skill.

The acid-base is one of the most closely related chemical matter in everyday life. The existence of practicum activities to find the concept and prove the existing theory will improve students' practical skills in the society. Given the many acid and base substances that can be found in the environment, students are required to respond to their environment. Sorgo & Spernjak (2012) stated that chemistry is recognized as the basis of experimental science: experimentation as the basic method of school work that requires students to study chemistry and scientific literacy, thereby generating positive attitudes toward chemistry and science. Therefore, it needs an integration between theory and practice in chemistry learning. In fact, students' practical skills have not been optimally developed. Laboratory facilities are not widely used by teachers as supporting learning activities. In addition, learning at schools with practice methods is still verificative. Students have not been trained to build their own knowledge. They still wait for instructions given by their teacher, so that their practice skills and thinking ability are not improving. Students have not been accustomed to connect chemistry learning with daily life. This condition causes them lack of scientific literacy, whereas scientific literacy is very urgent to be implemented. Scientific literacy will make students understand the concept of science, master the skill of scientific process and apply them for the community's needs. Therefore, it is necessary to improve the learning process which was previously the teacher-centered to be the student-centered learning. The goal is that students are more motivated to follow the learning process.

Selecting a right learning model is one component to achieve succeeded learning objectives (Marzano, 2013: 7), by applying a appropriate learning model such as project based learning (PjBL). PjBL is considered an effective and attractive learning method. PjBL provides an effective way to produce critical, analytical, creative, innovative, responsive, and reflective students in addressing the 21st century competencies. Holm (2011) defined project-based learning as a student-centered teaching method by utilizing projects to facilitate students' learning. The criteria for project work for grouped students are interesting topic selection and determination of their learning direction, discussion and providing feedback to each other; They may use the teacher as a resource, but generally they create their own knowledge (Musa et al., 2012). George Lucas Educational Foundation (2005) developed learning steps in PjBL, which consists of: (1) problem presentation by essential questions; (2) project planning or execution; (3) scheduling the project completion activities; (4) The teacher monitors the progress students' project; (5)

Students' work assessment; and (6) evaluation of students' learning experiences. Wiyarsi & Partana (2009) stated that the implementation of project-based learning model is very realistic for chemistry learning that requires practical work.

Practical skill is required to improve students' psychomotoric aspects in supporting relevant theories or concepts and also positively support the curriculum development. Chemistry learning should involve practicum activities to prove the truth of abstract concepts. Sneddon & Hill (2011) stated that at the school level, laboratory work is found to be an interesting feature of chemistry learning. Practical skill enables students to know the essence of an experiment and the relevance of each work procedure performed (Shallcross, 2013). Central Board of Secondary Education (2008: 13-14) classified practical skills into 4 categories: procedural and manipulative skill, observational skill, drawing skill, and reporting and interpretative skill. The process of chemistry learning requires practical work activities to prove the theory studied to develop students' practical skills. Practical work can be done in the laboratory through project activities.

Chemistry learning should not merely oriented to problem solving and practice skills. Therefore, chemistry learning needs to focus on the interaction of science, technology, and society with regard to local issues, public policy, and global issues known as scientific literacy. The Program of International Student Assessment (OECD, 2003: 133) states that scientific literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence to understand and help make decisions about the world and its changes through human activity. PISA 2015 defined the characteristics of scientific literacy consisting of four interrelated aspects for the purpose of assessment, namely context, knowledge, competence, and attitudes (OECD, 2013: 11). Furthermore, PISA (2013: 7) stated that someone who has scientific literacy achieves certain competences, namely: (1) able to explain the scientific phenomenon; (2) able to evaluate and design scientific research; And (3) able to interpret data and present scientific evidence. Scientific literacy does determine the development of civilization society because it is an important ability possessed by every individual considering all information at the present cannot be separated from science and technology (Komek, Yagiz, & Kurt, 2015). The purpose of this research is to determine the difference of implementation of PjBL model with DI model on acid and base chemistry learning for enhancing practical skill and scientific literacy of grade XI.

▪ METHOD

This research was a quasi-experimental research which uses non-equivalent pretest-posttest control group design (Sugiyono, 2013: 166). First, the two research classes were given pretest in the form of type A scientific literacy test. Then, the two classes carried out the learning; the experimental class implemented the PjBL model, while the control class implemented the DI model. During the learning process, the practical skills of students from the experimental class and control class were assessed through observation technique. Finally, the two research classes were given posttest in the form of type B scientific literacy test.

Population and Sample

The population in this study was all students of grade XI science of senior high school who equivalent to MAN 3 Yogyakarta. Sampling was done by purposive sampling technique, so it took two classes from the five existing classes. Subsequently, lottery system was taken and resulted the XI MIPA 1 class as the experimental class and XI MIPA 2 class as the control class.

Data Collection

Data collection technique included tests and observation. The test was done with the aim to know the level of students' scientific literacy ability before and after the implementation of model PjBL and DI. The scientific literacy measured consisted of the process dimension (aspect of competence) and the attitude dimension. Observation was done to know the development of students' practical skill as a result of the implementation of PjBL and DI model. The practical skills assessed include procedural and manipulative skill, observational skill, drawing skill, and reporting and interpretative skill.

Research Instrument

The data collection instrument used in this research was pretest and posttest concerning scientific literacy ability in the form of descriptive tasks and 6 observation sheets of students' practical skills using 3 assessment criteria (1, 2, and 3). Besides, it was used learning instrument which included syllabus, Learning Implementation Plan (RPP) prepared based on the KI and KD of 2013 Curriculum on acid and base material, and Student Work Sheet (LKPD) prepared based on the PjBL model syntax for 6 meetings.

Data Analysis

Data analysis techniques used were descriptive analysis and statistical analysis. Descriptive analysis was used to present the data obtained from the tests and the observation, while statistical analysis was used to test the research hypothesis. Hypothesis test was Manova test using SPSS 21 assistance. Before the Manova test analysis, some prerequisite tests were conducted which consisted of normality test, homogeneity test and correlation test. The level of significance (α) used, ie 5% with the test criteria H_0 is rejected if the significance value is less than the value of α.

▪ RESULT AND DISCUSSION

The data of practical skills is obtained through the observation result for 6 meetings in the form of accumulated score from each meeting. The scientific literacy data were the pretest and postest values of the two classes which were then converted to normalized gain (n-Gain).

Table 1. Percentage of Students' Practical Skill Observation Results

Aspect of *Practical Skill*	***Practical Skill* (%)**	
	Eksperimental Class	**Control Class**
Procedural and Manipulative Skill	91.53	80.32
Observational Skill	95.41	88.10
Drawing Skill	91.36	76.94
Reporting and Interpretative Skill	92.59	77.78

Based on Table 1, the difference in the values of the four practical skill aspects between the control class and the experimental classes indicates that the control class students are less skilled in practicum activities and in the range of other learning activities.

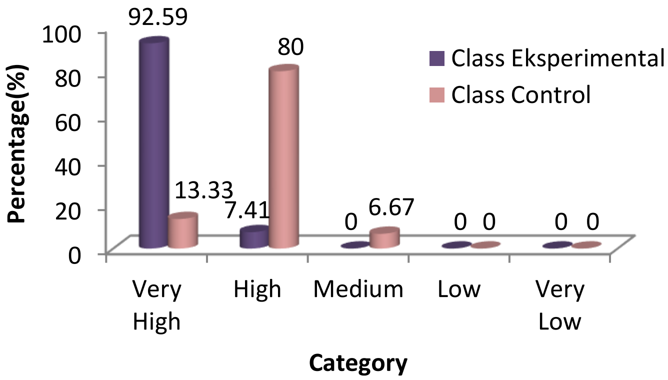

Figure 1. Frequency of Practical Skill Rating Category

Based on Figure 1, the practical skills of experimental class students are better than the control class students in all four aspects of the assessment. The practical skills of experimental class students fall into two categories, which are very high and high, while in the control class fell into three categories, namely very high, high, and medium.

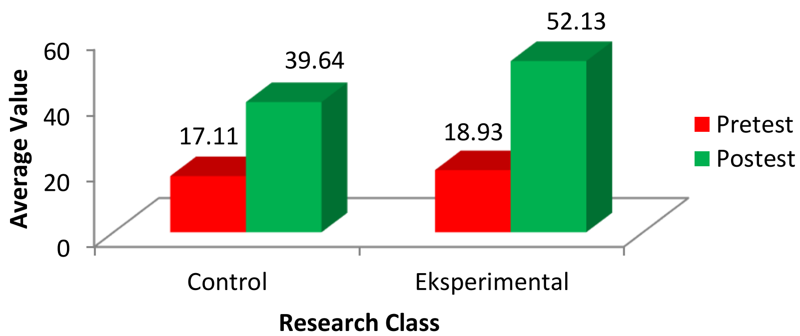

Figure 2. Average Value of Scientific Literacy Test

The results of pretest between the two classes were not much different, so it can be said that the students' early ability between of the control class and experiment class were the same. In the mean time, the average post-test value of the experiment class was higher than the control class. These results indicated that the experimental class's scientific literacy is higher than control class after the treatment.

Table 2. Normalized Gain of Scientific Literacy

Class	**n-Gain**
Control	0.27
Eksperimental	0.42

Based on Table 2, the pretest and postest values have been converted to n-Gain. The average n-Gain of experimental class is higher than the control class and was statistically significantly different.

Normality and homogeneity tests used n-Gain scientific literacy data. Normality test used Kolmogorof-Smirnov test statistic. The results of the analysis test showed that the significance values of the experimental class and control classes were 0.2 and 0.07 respectively. Both significance values were greater than α value (0.05), which means H_0 is accepted, thus, it can be concluded that the sample came from a normally distributed population. Homogeneity test used Levene test statistic. Based on the analysis test, it was obtained a significance value of 0.085. This significance value was greater than α value, which means H_0 is accepted, thus, it can be concluded that the sample came from a homogeneous variance.

Correlation test used n-Gain data of scientific literacy and practical skill scores. The correlation test used Pearson test statistic. Based on correlation analysis test, it was obtained a significance value of 0.000. This significance value was smaller than α value, which means H_0 is rejected and H_a accepted. Hence, it can be concluded that there is a correlation between scientific literacy and practical skill.

After the prerequisite tests were received, hypothesis test was taken using Manova test statistic gives the result as shown in table 3.

Table 3. The Results of Manova Test

Test Statistic	**Significance Value**
Hotelling Trace	0.000
Corrected Model: Practical Skill	0.000
Corrected Model: Literasi Sains	0.000

According to Table 3, it was obtained a significance value less than α, which means H_0 is rejected and H_a is accepted. Thus, it can be concluded that there is a significant difference between the PjBL model and the DI model on acid and base chemistry learning to improve: (1) practical skill and scientific literacy; (2) practical skill; and (3) the scientific literacy of the 11^{th} grader.

The results of statistical analysis show that there is a significant difference between the implementation of PjBL model with the DI model in improving students' practical skill and scientific literacy. This statement implies that the practical skill and scientific literacy of the experimental class students are better than the control class.

1. The Effect of PjBL Model on Practical Skill

The observation result shows that the values of four practical skill aspects of the experimental class are higher than the control class's. This fact is reinforced by the result of hypothesis test statistically, which shows that there is a significant difference between the PjBL model with the DI model implementation on acid and base material for improving the 11th students' practical skills of MAN 3 Yogyakarta students. This difference is due to the students only followed the direction and explanation from the teacher. In contrast, the experimental class applied the PjBL model. The teacher's role in PjBL is not as the information provider but as an investigation facilitator (Zhenyu, 2012).

The PjBL model involves students to actively move in investigation activities from designing experiments to interpreting data and reporting the data. Therefore, the practical skill of the experimental class is better than the control class after the treatment. This fact is relevant to the results of research Mulyadi (2015), namely the implementation of PjBL model can improve the performance of the grade XI AV1 students of SMKN 3 Yogyakarta on physic learning. Toplis & Allen (2012) explained that practical work can strengthen the theory and teach students to be real scientists. Chemistry learning is a learning that requires a balance between "minds on" and "hands on". Therefore, the implementation of PjBL model can be a way to develop students' practical skills.

2. The Effect of PjBL Model on Scientific literacy

The results of this research shows that the average values of the pretest and postest for the experiment class are higher than the control class. This result is reinforced by significant n-Gain values between the experimental class and the control class. That is, there is a significant difference between the implementation of PjBL model with DI model on acid and base chemistry learning for improving the scientific literacy of the grade XI students of MAN 3 Yogyakarta. The students' scientific literacy got higher after the implementation of PjBL model. These results also indicate that the level of understanding and mastery on acid and base material by the experimental class is better than control class. This fact is relevant to the results of research Susilowati, Iswari, & Sukaesih (2013) which showed that the post-test average value of the class using PjBL is higher than the class using conventional learning.

Through PjBL, students become more sensitive to recognize scientific issues in their environment. They are invited to get to know chemistry in life more closely. This condition makes students know the relevance of chemistry learning materials with daily life, so that chemistry learning becomes meaningful to them. In addition, they are also trained to make decisions in solving problems regarding the phenomenon that occurs. Overall, each PjBL syntax trains the dimension of students' process and scientific literacy attitude. Students are more skilled in explaining scientific phenomena, interpreting data and presenting scientific evidence, and evaluating and designing scientific research. In addition, they are also more responsible for the resources and environment. Thus, PjBL can increase students' scientific literacy, that is through scientific investigation, so that they do not only learn chemistry as a product, but also as a process and implementation. This statement is in accordance with the opinion of Gucluer & Kesercioglu (2012) which stated that scientific literacy includes three important points in science, namely: (1) theory, principle, and concept of science; (2) science process skills; and (3) science implementations including science and technology and public relations with the environment.

3. The Effect of PjBL Model on Practical Skill and Scientific literacy

The result of analysis using manova test showed that there is a significant difference between the implementation of PjBL model with DI model on acid and base chemistry learning for improving practical skill and scientific literacy of the grade XI students of MAN 3 Yogyakarta. Students of the experimental class showed better practical skills and scientific literacy than the control class. That is, there is a connection between practical skills and scientific literacy. The learning more dominantly used practical methods and group discussions aimed at exploring students' skills and competencies. In addition, this method was chosen to make students more motivated to learn, because the previous learning by lecturing method tended to caused boredom. This statement is seen from the students' attitude when the learning took place. They were very enthusiastic in doing lab work in the laboratory. Abrahams & Millar (2008) stated that practical work is relatively rewarding and enjoyable for students compared to other science and learning activities.

Theories no longer have to be memorized and become memorable, since the students themselves who experiment, explore important information and data, and find concepts. Furthermore, students can apply that knowledge in everyday life, so that their scientific literacy increases as their practical skills improve.

Through PjBL, students gain knowledge and skills through various activities and in various domains (Tamim & Grant, 2013). Students design experiments based on question formulation to solve existing problems. Next, they do the experiments based on the design to find the concept. Through this activity, they are required to be able to explain scientific phenomena that occur based on the results of experiments and report their findings. Thus, the activities in PjBL cover all aspects of students' practical skills and scientific literacy dimensions, so that the practical skill and scientific literacy of the experimental class students are better than the control class.

4. The Quality of PjBL Learning Model

PjBL is based on constructivism theory, which trains students to build their own knowledge. This condition requires them to be active, not merely to be listeners, recorders, and memorizers. PjBl is able to improve the way students learn so that it is able to increase their thinking skills and practice skills. PjBL is a student-centered learning model. The learning activities are dominated by students. Teachers act as facilitators and motivators for students to gain knowledge, understanding, and skills. Students do project activities as a problem solving based on the phenomena presented by the teacher. This explanation is in accordance with the opinion stated by Stozhko et al. (2013) that students are actively involved in the learning process by developing projects related to important practical problem solving.

PjBL begins with formulating essential questions based on the phenomenon that occurs. The phenomenon or problem is taken from everyday life. This is in accordance with Wena (2011: 155) that one of the PjBL principles is learning from the real world. The second stage, students plan the project, which is designing scientific experiments ranging from determining the tools and materials needed to determine the working procedure to be performed. The third stage, students determine the project activity schedule, ie how long they will complete the project. The fourth stage, teachers monitor students' activities during the project completion. The fifth stage, students are asked to present their design and findings to be assessed by the teacher. In the sixth stage, teachers and students evaluate the project activities and equate perception of conceptual correctness.

The PjBL model was applied six times with 2x45 minute for each meeting. Students were divided into five groups of 5-6 students each. Each group was given an LKPD structured based on the PjBL syntax, containing project designs to be made and a number of questions to be answered by students. The PjBL model asked students to define project design, including the determination of tools and materials and work procedures. Project design was prepared as an effort of solving problem provided. Students in the experimental class were free to choose the chemicals that would be used in the project, so in project presentation, they obtained more information.

The first meeting of the experimental class was still unfamiliar with the implementation of the PjBL model. This condition was caused by the shift of the learning strategy which previously tended to be teacher-centered became student-centered learning. As result, this caused students confused about the learning process. However, clever teachers provide scaffolding to guide students towards the desired learning objectives, so that students could still follow the learning process according to the PjBL syntax. Although this learning model was still unfamiliar to students, they looked enthusiastic during the learning process. The second until the fifth meeting, students got more accustomed to learning using the PjBL model. The third meeting was a bit problematic on the laboratory equipment to be used. The pH measurement only used the universal indicator, because the pH meter did not work properly. However, at the evaluation stage, the teacher advised how to use pH meter correctly. The sixth meeting, students felt rather difficult to design the project. This condition was because they do not know the tools used for acid-base titration method, so the teacher gave a scaffolding again. They also did not know the correct working procedure in performing acid-base titration method. Once directed by the teacher, they could do the titration and were quite skilled at doing so.

Meanwhile in the control class, the teacher continued to apply the learning as usual. Theories and concepts were submitted first using lecturing and questioning-answering methods. After that, it took a practicum to prove the truth of the concept that has been given. This condition was less train the students' scientific literacy. Students tend to memorize concepts and are unfamiliar in designing scientific research, explaining scientific phenomena, and interpreting scientific data. Practical activities are still verifikatif. Students await instruction from the teacher and all are available in LKPD, so the practical skills of the students are poorly trained.

The PjBL model has many advantages over the DI model. Triling & Fadel (2009: 109) explains that PjBL is effective because it has five characteristics, namely: (1) project results related to curriculum and learning objectives; (2) essential questions and problems directing learners to the center of concept or principle; (3) the investigation and research of learners involves the discovery and building of knowledge; (4) Learners are responsible for designing and managing their own learning; And (5) projects based on real-world issues and authentic questions about the material being studied.

▪ CONCLUSION

Based on the assessment and the purpose of the research, the conclusion is that PjBL model is more effective than DI model for enhancing students' pratical skill and scientific literacy wholly and partially.

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