The Use of Explorative Learning Model with Inquiry Labs Method and Verification Laboratory Method for Improving Students' Skill Process

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Abstract: This study aims to determine differences in the improvement of students' science process skills that get explorative learning model with inquiry labs method and laboratory verification method. This research uses two classes as the sample, they are one class of experiment and one class of control class XI SMA Negeri 2 Pulau Punjung, Dharmasraya Regency, West Sumatra. The experiment class is a class that accepts explorative learning model with inquiry method in the class of control class that is the class that accepts explorative learning model with laboratory verification method. The research method used is a quasi-experiment with the design of the randomized pretest-posttest control group design. The result shows that the students' science process skills increase and the normalized gain scores <g> for the students' science process skills in the experiment class is 0.54 and the control class is 0.40. Data processing is done by t-test statistic for the average difference. The result of the research shows that the application of explorative learning model with inquiry labs method on the concept of elasticity can significantly improve the students' science process skills compared with the use of explorative learning model with verification laboratory method.

1 INTRODUCTION

Physics is related to how to systematically find out about nature so that physics is not only mastery of a collection of knowledge in the form of facts, concepts or principles but also the process of discovery (Ministry of National Education, 2006). In addition, natural science is a basic science that is developed based on the results of scientific discovery related to the events of nature every day. Therefore, the application of physics learning cannot be separated from processes and products. Science learning has goals that are closely related to the environment and everyday life. This is in line with the functions and objectives of Physics subjects at the secondary school level as a means of: i) Arousing the beauty and regularity of nature to increase trust in God, ii) Fostering a scientific attitude that includes; honesty and objective with respect to data, open in accepting opinions based on certain evidence, critical of scientific statements, and able to work together with others, iii) Providing experience to be able to propose and test hypotheses through experiments; designing and compiling experimental instruments, collecting, processing and interpreting data, compiling reports, and communicating experimental results from written and oral experiments, iv) Developing the ability to think inductive and deductive analysis using concepts and physical principles to explain natural events and solve problems both qualitatively and quantitatively, v) Mastering knowledge, concepts, and principles of physics, and possessing scientific knowledge, skills and attitudes (Ministry of National Education, 2003).

Therefore, in the learning process emphasis should be placed on learning activities that train students to have process skills. Rustaman (Rustaman, 2006) suggests that the basic skills of scientific work consist of emotional intelligence and intellectual intelligence. Intellectual intelligence is largely a science-process skill (SPS) in primary and secondary education, which includes observing, interpreting, classifying, predicting, communicating, hypothesizing, planning experiments, applying concepts, and asking questions.

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The case study report conducted in 2014 showed that cognitive physics learning outcomes from 25 students were still low, especially in understanding science process skills. In the results of student science skills tests, 25% aspects were observed, hypothetical aspects were 47%, predictions 45%, identification aspects 35%, 49% aspects of data interpretation, 20% aspects of conclusions. From all aspects, it can be concluded that students' science process skills are in the low category. This is due to the learning process is lacking in facilitating and training aspects of students' skills.

Explorative learning is a learning aimed at exploring different ideas, arguments and ways from students through a number of open questions and commands that can lead the students to an understanding of concepts and solving problems. In this approach, students become active explorers and teachers serve only as mentors and exploratory facilitators.

The purpose of exploration activities is to enable students to engage broadly in problem-solving. The role of the teacher in the exploration activities is as a facilitator and guide during the activation process, the teacher facilitates the possibility of exposing the students' ability in expressing different ideas, arguments, and ways of finding concepts or solving problems through explorative problems.

In order for the learning process to be in accordance with the nature of physical learning and students can build on the concept of knowledge that they already have, it requires learning methods that facilitate it. One method that can be applied to achieve that goal is investigation. This investigation will bring the impact of learning on the positive mental development of students because through this learning, students have a wide opportunity to find and find out for themselves what is needed especially in abstract learning.

Thus, it is important to apply laboratory activities to the method of inquiry in conducting physics learning. Implementation of this method is expected to improve students' science process skills. In general, the literature study conducted by Rohaeti, Dwirahayu, Roth et al., Tamir, etc. (Rohaeti, 2008; Dwirahayu, 2012; Roth et al. 2003; Tamir, 2005), shows the results of physics learning using investigative lab methods can support to improve some of the skills that exist in students and the interest of students to follow the learning process.

Physical learning in schools is generally done through verification of laboratory activities. Many concepts, principles, and laws can be well developed through a deductive approach, where teachers teach concepts in the classroom, followed by laboratory activities to verify attributes and relationships.

2 RESEARCH METHODS

The method used in this research is Quasi-method of the experiment. This design has a control group but cannot function fully to control the outside variables that affect the experiment execution (Sugiyono, 2010). The use of the quasi-experiment method is used to find out the comparison of science skill improvement among students who get explorative learning with inquiry labs method and students who get explorative learning by laboratory verification method.

The design used in this research is The Randomized pretest-posttest control group design, which is a research design where initially one experiment group measured its dependent variable (pre-test). After that, the group is given treatment, and the dependent variable is re-measured (post-test). The research design of The Randomized Pretest-Posttest Control Group Design (Fraenkel and Wallen, 2009) is more clearly seen in Table 1 below:

Table 1: Randomized Control Group Pretest-Posttest Design.

Category	Pre-test	Treatment
Experiment Class	O	X_1
Control Class	O	X_2

Information:

O : pre-test and post-test to measure science process skills

X_1: Treatment using explorative learning model with inquiry labs method.

X_2: Treatment using explorative learning model with verification laboratory method.

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For a best viewing experience, the used font must be Times New Roman, on a Macintosh use the font named times, except on special occasions, such as program code (Section 2.3.7).

2.1 Population and Sample

The population in this research is all students in SMA Negeri 2 Pulau Punjung in the odd semester of academic year 2013/2014. The sample in this research is class XI SMA N 2 Pulau Punjung. From a number of classes, it will be determined two classes using cluster random sampling technique. The technique used is the drawing technique. The drawing technique is performed to determine the control class and the experiment class. One selected class is used as the experiment class that will receive learning treatment using explorative learning model with inquiry labs method. The other one class as a control class that accepts learning using an explorative learning model with a verification laboratory method. Another class that functions as a control class accepts learning using an exploration learning model with a verification laboratory method.

The data were collected during pre-test and post-test using science skill test. Science process skill tests are multiple choice questions that include aspects of observing skills, concluding, identifying variables, predicting, hypothesizing, and interpreting. The test has been tested for validity, reliability, distinguishing power and convenience level test.

2.2 Data Analysis

Analysis of data is intended to make interpretation of data obtained from research results. The data analysis is used to know the improvement of students' science process skill.

2.2.1 Scores on Pre-test and Post-test Results

Before data processing is carried out, all the pretest and posttest answers of students are examined and scored. The correct answer is ranked first and the answer is incorrect or not answered with a zero value.

2.2.2 Calculating a Normalized Gain Score (N-Gain)

Normalized gains are the comparison between the gain scores obtained by students with the maximum gain scores that can be obtained (Hake, 1999). They can be mathematically written as follows:

$$g = \frac{S_{post} - S_{pre}}{S_{m\ ideal} - S_{pre}} \quad (1)$$

Information:
g = normalized gain
S_{post} = final test score obtained by the student
S_{pre} = initial test score obtained by the student
$S_{m\ Ideal}$ = ideal maximum score

2.2.3 Determine Normalized Average Gain Scores

To find out the improvement of students' science process skills in the elasticity material, normalized mean score data were processed using equations developed by Hake (1999), namely as follows:

$$\langle g \rangle = \frac{\langle S_{post} \rangle - \langle S_{pre} \rangle}{S_{m\ ideal} - \langle S_{pre} \rangle} \quad (2)$$

information:
$\langle g \rangle$ = normalized average gain scores
$\langle S_{post} \rangle$ = the average score of the final tests students get
$\langle S_{pre} \rangle$ = the average score of the initial tests students get
$S_{m\ Ideal}$ = ideal maximum score

2.2.4 Introduces a Normalized Average Gain Score using Table

Tabel 2: Interpretasi Skor Rata-Rata Gain yang Dinormalisasi (Hake, 1999).

<g>	Criteria
$\langle g \rangle \geq 0,7$	High
$0,3 \leq \langle g \rangle < 0,7$	Medium
$\langle g \rangle < 0,3$	Low

2.2.5 Hypothesis Testing

To further strengthen whether the data obtained has a significant increase or not, it is necessary to have two different test averages (hypothesis testing). This hypothesis test consists of several steps that must be passed to achieve the right results. The following are steps that must be taken to test the hypothesis using the help of SPSS 16.0 data processing software for Windows.

1) Normality Test of N-Gain Data
Normality test aims to determine the distribution of data obtained. Normality test used in this study is Kolgomorov-Smirnov test with a significance level ($\alpha = 0,05$). If the value $sig. > \alpha$ then Ha accepted. In other words, the data is normally distributed.
2) Homogeneity Test of N-Gain Data Variance
The homogeneity test was conducted to see whether the data values obtained from these two groups had the same variance or not. In this study, homogeneity test was performed by using Levene Test (Test of Homogeneity of

Variances) with a significance level ($\alpha = 0,05$). If the value $sig. > \alpha$ of Ha is accepted. In other words, the variance for both data is homogeneous.

3 RESULTS AND DISCUSSIONS

Testing the application of explorative learning model with inquiry labs method to improve the science process skills on the concept of elasticity is done by comparing the normalized average gain values between experiment classes using explorative learning model with inquiry labs method with control class using explorative learning model with laboratory method verification. Comparison of the mean initial test scores, the final test and the normalized gain (in percent) between the experiment class and the control class are shown in Figure 1.

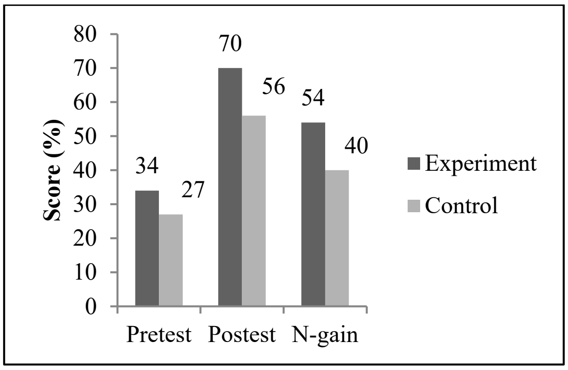

Figure 1: Bar chart Comparison of Average Scores Initial Test, Final Test and Normalized Gain.

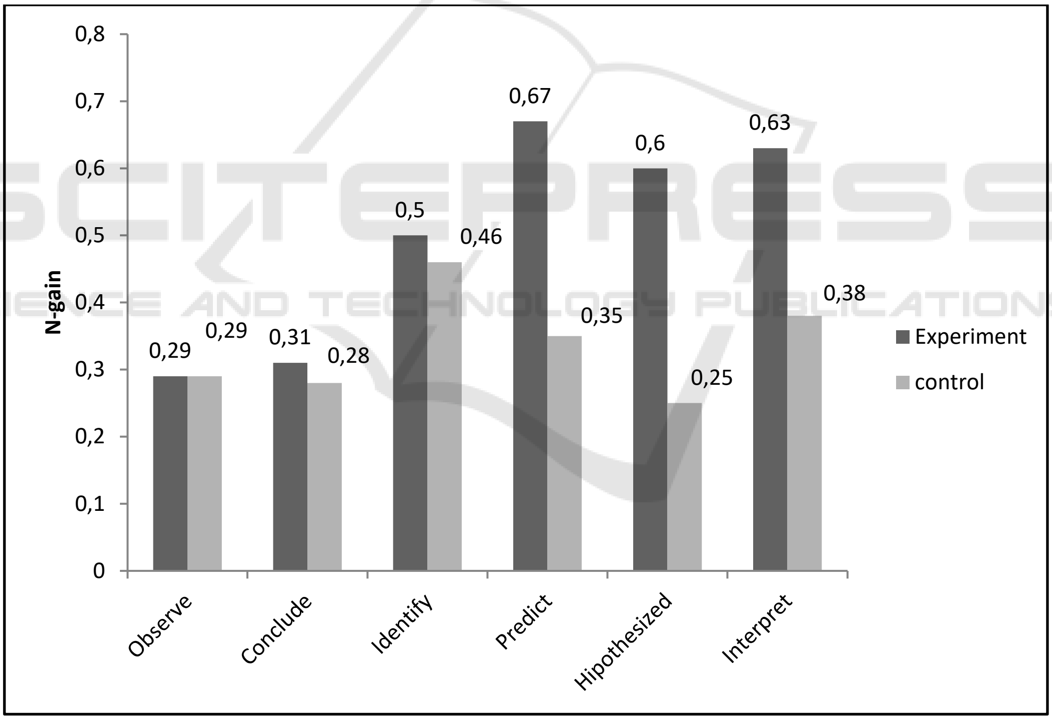

Figure 2: Normalized Mean Gain Value Chart Diagram Per Type of Science Process Skills.

Based on Fig. 1, it was found that the normalized gain-averaged values for the experiment class were 0.54 in the medium category and the normalized average gain for the control class was 0.40 in the moderate category. This direct comparison of values demonstrates that the use of explorative learning models with inquiry labs methods can more effectively improve students' science process skills on the elasticity concept than the verification laboratory model.

Improved science process skills can be grouped for each type of skill that is, observing skills, concluding, identifying variables, predicting, hypothesizing, and interpreting. Normalized gain values for each type of science process skill for the experiment class and control class are shown in Figure 2.

3.1 Observing Skills

The type of observing skill is the skill of collecting data on phenomena or events using its senses. Observing is the foundation for all other process skills. In other words, through observation, we collect data about our responses. In the learning process, students are asked to observe either a picture or a natural phenomenon related to elasticity either in the form of a direct phenomenon or a tool that can indicate an elasticity event.

Based on Fig. 2, the normalized gain averaged for the experiment class is 0.29 (low category) and the normalized gain value for the control class is 0.29 (low category). It can be seen that the improvement of the type of science process skill observed in the experiment class is the same as the control class.

3.2 Concluding Skills

The conclusion is an explanation one uses of what is observed to explain something that has happened. The conclusions are based on observations and explanations of observations.

Based on Fig. 2, the mean gain values of normalized skill concluded for the experiment class were 0.31 (medium category) and the normalized gain value for the control class was 0.28 (low category). In this type, the normalized average gain ratio between the experiment class and the control class is not too large.

3.3 Identifying Variable Skills

A variable is a quantity that can vary or change in a given situation. Based on Fig. 2, the mean values of the normalized gain of the skill in identifying the variables for the experiment class were 0.5 (medium category) and the normalized gain values for the control class were 0.46 (medium category). In this type, the normalized average gain ratio between the experiment class and the control class is not too large.

3.4 Predicting Skills

The predicting skill is the submission of results that may result from an experiment. Prediction is based on previous observations and inferences.

Based on Fig. 2, the normalized average gain values for the experiment class are 0.67 (medium category) and the normalized gain values for the control class are 0.35 (medium category). If the normalized average gain values for the two classes can be seen, the use of explorative learning model with inquiry labs method can more effectively improve the students' prediction skills on the elasticity concept compared with the verification laboratory model.

3.5 Hypothesis Skills

The formulation of the hypothesis is the formulation of a reasonable guess that can be tested about how or why something happened. Hypotheses are often expressed as statements if and then. Based on Fig. 2, the normalized average gain values for the experiment class were 0.6 (medium category) and the normalized gain-averaged values for the control class were 0.25 (low category).

In general, based on the normalized average gain values for the two classes, it can be concluded that the application of explorative learning model with inquiry labs method can more effectively improve students' hypothesized skills on the concept of elasticity compared to the class using the verification laboratory model.

3.6 Data Interpretation Skills

The skills to interpret data is to explain the meaning of information that has been collected. Included in interpreting data is entering data into a table and drawing graphs of data obtained or vice versa. Based on Fig. 2, the normalized gain averaged the experiment data skill for the experiment class is 0.63 (medium category) and the normalized gain value for the control class is 0.38 (medium category). In this type the normalized average gain ratio between the experiment class and the control class is large.

In general, based on the normalized average gain values for the two classes, it can be concluded that the application of explorative learning model with inquiry labs method can more effectively improve the communication skill on the concept of elasticity compared to the class using the laboratory verification model.

Based on the description of the improvement of science process skill, it can be concluded that the application of explorative learning model with inquiry labs method is more effective in improving the science process skills on the concept of elasticity compared to the class using the laboratory verification model.

3.7 Skills Improvement of Student's Science Process on Elasticity Concept

Based on the results of pre-test data analysis of science process skills on the concept of elasticity, it is known that the average score of the control class is not too much different from the experiment class before the application of the model of laboratory activities. Thus, it can be concluded that both classes have the same initial ability. This is because some concepts of elasticity have been studied by students in junior high schools, and the context of pre-test problems faced by many students on a daily basis. The two classes were given different learning treatments that controlled the class using an exploratory learning model with laboratory verification methods while the experimental class used an exploratory learning model with an investigative laboratory method. To find out the improvement of students' science process skills, the posttest was implemented and the results were analyzed.

Observation skills did not show a high N_gain difference between the experiment and the control class because in the laboratory activities, the students were poorly trained to observe the experiment activities. Similarly, the low N_gain difference in the ability to plan the experiment. On the skills of identifying these variables, the experiment class students are trained to design experiment steps with guided by method questions. But from the posttest result, it turns out the N_gain difference is not too high. This is presumably because the instruments to test these skills are less able to measure the skills of identifying variables.

Based on the result of data analysis, students who get learning with explorative learning model with inquiry labs as a whole method show their science process skill better than those who get learning with the model of verification laboratory activity. The high acquisition of posttest score and the normalized gain of the experiment class is caused by the explorative learning model with the inquiry labs method directing the students to various activities such as observing skill, concluding, identifying variables, predicting, hypothesizing, and interpretation.

Dahar (Dahar, 1985) states that when a child during science learning is only informed about existing science by listening to teacher explanations, the science itself will stop growing. Science is not just knowledge that consists of facts, principles, concepts, and theories known as science products, but also the skills and attitudes necessary to achieve a product of science known as the process of science.

This is in line with Rustaman (Rustaman, 1997) who defines the skills of the scientific process as the necessary skills to acquire, develop and apply the concepts, principles, laws, and theories of science in the form of mental skills, physical skills, and social skills. The skills of this science process can be improved with an explorative model. Through these step-by-step laboratory models, students are guided and directed to initiate activities by identifying contextual problems, preparing tools and materials to solve problems, predicting problem solutions, devising experiment steps to solve problems/plan experiments, explore, measure, analyze the data obtained and conclude so the problem can be finished well.

The highest increase in the science process skills for the experiment class is on predicting skills with a normalized average gain value of 0.67 (medium category). This happens because, in the learning process, students are trained to be able to submit results that may result from an experiment. Prediction is based on previous observations and inferences. While the skill improvement of the lowest experiment class science process is on observing skill with the normalized average gain value of 0.29 (low category). This is because, in the learning process, students are poorly trained to observe either a picture or a natural phenomenon related to elasticity either in the form of a direct phenomenon or a tool that can indicate an elasticity.

The highest increase in science process skills for the control class is on the skill indicator of the variables with a normalized average gain value of 0.46 (medium category). This happens because in the learning process, students are able to identify variables from the experimental activities carried out. While the lowest increase in science process skills in the control class was on hypothesizing skills with a normal average gain of 0.25 (low category). This is because, in the learning process, students are poorly trained to form reasonable assumptions that can be tested on how or why something happens and the LKS used is verification of LKS.

Based on the results of the analysis and discussion above, it can be concluded that the improvement of the science process skills of students’ elasticity using explorative learning model with the inquiry labs method is significantly higher than the students using the laboratory verification model.

4 CONCLUSIONS

Based on data and analysis of the results of research conducted on exploratory learning models with inquiry lab methods in elasticity learning to develop science process skills, it can be concluded that exploratory learning models with inquiry lab methods can significantly improve science process skills compared to explorative learning models with methods laboratory verification. Improving the science process skills of students in the inquiry laboratory class is relatively better than that of students in the verification laboratory class.

REFERENCES

Arikunto, S 2006, *Prosedur Penelitian suatu Pendekatan Praktek.* Edisi V, Rineka Cipta, Jakarta.

Depdiknas, 2006, *Kurikulum 2006: Standar Kompetensi, Mata Pelajaran Fisika, Sekolah Menengah Atas dan Madrasah Aliyah,* Depdiknas, Jakarta.

Depdiknas, 2003, *Standar Penilaian Buku Pelajaran Matematika*, Pusat Perbukuan, Jakarta.

Hake, R 1999, *Analyzing Change/Gain Scores Dept. of Physics, Indiana University 24245 Hatteras Street, Woodland Hills, CA, 91367 USA.*

Rohaeti, E 2008,'*Critical and Creative Mathematical Thinking of Junior High School Student', Educationist* 4, (2), 99-106.

Roth, Michel, W & Roychoudhury, A 2003, '*The Development of Science Process Skills in Authentic Context', Journal of Research in Science Teaching,* Vol. 30, Issue 2, 127-152.

Rustaman,Y. N. *et.al*., 2006, *Strategi Belajar Mengajar Biologi.* Common Text Book JICA Edisi Revisi, Jurusan Pendidikan Biologi FPMIPA UPI, Bandung.

Sugiyono, 2010, *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif dan R&D*, Alphabeta, Bandung.

Tamir, P 2005, '*An Inquiry Oriented Laboratory Examination', Journal of Educational Measurement*, Vol. 11, Issue 1, 25-33.