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The Influence of SSP Based on Lab Work toward Science Process Skills of Students

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Abstract

This research aimed to find the influence of Science Process Skills between a subject spesific pedagogy (SSP) based on elaborative lab work group with the one, a SSP based on conventional lab work in the IX grade of SMPN 2 Tolitoli. It was quasi-experimental study using non equivalent control group design. Two classes were chosen by random sampling techniques, and each class consists of 31 students. The data of science process skills (SPS) that obtained through observation sheets were analyzed by descriptive analysis techniques on significance of 5%. The result showed that the significance was less than 0,005. It can conclude that the application of SSP during teaching and learning process of Science based on the elaborative lab work has significant influence on SPS of the students, compared with the conventional ones. It reinforced by the criteria of SPS improvement, for the experimental class in 0,5 (medium category) and 0,1 (low category) for the control class.

Kata Kunci: Subject spesific pedagogy, Lab work, Science process skills

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INTRODUCTION

Nowadays, education has become a primary need for every human being, including in Indonesia. Education is the most important element in advancing the nation and state. Because of education plays an important role in creating human resources (HR) quality, including in Indonesia, the quality of education must be increased. Thus, it will produce qualified and firm human resources who can compete with other nations, improve their living standards and welfare of the nation, and increase sustainable development. As it is declared that the goals of National Education are educating the nation and developing the human resources. Therefore, education must be held in a conscious way and clear goals. To respond this issue, government actually has done various attempts to improve the educational system in Indonesia. Such efforts among others are including the promotion of nine-year compulsory education, provision of free educational program, funding school operational assistance (SOA) to elementary and junior high schools, improvement of teacher's quality through teacher certification program, and creation of budget allocation for 20% of the national budget specifically for education.

In reality, the quality of education in our country is still low and far from the expectations. It is according to Jalal (2009), said that in the level of international community, the quality of education in Indonesia is still far from the expectations. This condition can be seen on the achievements of Indonesian students in Trend International Mathematics and Science Study (TIMSS), which is from year to year suffered a decline. In 2011 Indonesia was ranked 40 out of 42 participating countries (Mullis et al., 2011). Whereas in 2015, its rank was 45 out of 48 countries with an average score 397 out of 600 (Mullis et al, 2015). It provides an information that Indonesian students are lack of the content and cognitive. Even for the science literacy achievement in Program for International Student Assessment (PISA) (OECD, 2014) in 2012, Indonesia got rank 64 out of 65 countries, between Qatar and Peru, with an average score of science subject was 385, while the average score of the Organization for Economic Cooperation and Development (OECD) was 501. Likewise, in 2015, Indonesia obtained its rank at 69 of 76 countries with an average score of 403 (OECD, 2016). According to that statement, Rahmawati et al. (2014) state one contributing factor which causes this problem is about the students' habit during teaching and learning process. At school, the students only pay attention to their teachers' explanation about facts and concepts without trying to seek and find any additional information which is relevant with their material by themselves. For this reason, students in Indonesia still need to improve their ability to integrate information, draw conclusions, and generalize knowledge to other things (Rahmawati, 2016).

Teacher is a profession, it is such an occupation which is needs a special skill and not any people can perform this task. To be a professional teacher, oneself must have acquired knowledge to support their task as an educator (Rustaman, 2005). One of the task of a proffes-sional teacher is providing an opportunity for the students to learn well, hence one of the factors which possibly improve the teacher's role effectiveness is by empowering their PCK (William & Lockley, 2012). It is an assimilation between pedagogical knowledge and content knowledge which develops every time by experiences. PCK is an ability to present about the way to motivate which is changes dynamically every time through experiences on how to apply particular material content to students during teaching and learning process, in order to make them successfully achieve their understanding (Loughran et al, 2012). According to Shulman (1986), Content Knowledge covers conceptual knowledge, theory, idea, brainstorming, method of proof and evidence. Meanwhile, Pedagogical Knowledge is related to the way and process of teaching which encompasses the knowledge about class management, assignment, lesson plan, and teaching and learning activity (Shulman, 1986). PCK also includes the ways which represent or formulate material in order to achieve an understanding (Resbiantoro, 2016). PCK covers main activity of the teaching and learning process, curriculum, scoring, and evaluation which deals with the process of teaching and learning, and the relation of curriculum, scoring, and pedagogy (Mishra & Koehler, 2009). PCK of teacher will be dealing with the students' acceptance; it is derived from students' ability in accepting and processing information, mental efforts, and report of study (Rahmadhani et al, 2016).

Generally, science education has an important role in improving the quality of education, especially in producing qualified students, those who are able to think critically, creatively, logically and take the initiative in responding to the issue in the community caused by the impact of the development of science and technology (Folmer, 2009; Khan et al, 2011). One of the most important goals of education is explaining the students about the nature of science and teaching them, how to get themselves involved in the investigation which have result then produces a product. The product namely produces facts, concepts, principles, theories, and laws (Zeidan & Jayosi, 2015; Feyzioğlua, 2012). Science applied at schools should include two essential components, namely the product of science and science process. The product of science is an accumulation of empirical and analytical results of the activity of scientists. The product of science which is produced is derived through the process of scientific investigation involving the scientific manner and the process of science, meanwhile science as a process includes skills and manners possessed by scientists when investigating natural phenomena to produce science (Khan & Iqbal, 2011).

Science essentially as a product that should certainly consider the strategies or methods effectively and efficiently. Practical activities in one of the suggested activities. In carrying out practical activities, it needs supporting facilities which will make lab work goes well. In junior high school, lab work is conducted in science lab. The lab work would be helpful in science learning process. Through the approach of laboratory activities, students can gain direct experience of physical symptoms. Science as a study which has its own characteristics is considered not only enough has learned just by the mind on, but also through a hand on (Indrawati, 2010).

Science is an approach to the study about nature. Science as an academic discipline involves learning concepts and processes (AGI, 2013). The purpose of science education is to help the students to understand scientific knowledge and develop students' skills in scientific inquiry (Guevara & Almario, 2015). Science learning which occurs in the field is still using classical methods, so that students tend to be difficult to understand the scientific concepts which are largely abstract. Subagyo et al. (2009) state that the nature of learning science is not enough simply to remember and understand the concepts which is found by scientists. It is the habitual behavior of scientists in discovering the concept through trial and scientific research. According to Chiapetta & Kobbala (2010), the intended outcomes will dictate the type of laboratory needed. Each type of laboratory approach has different characteristics with other approaches. In general, most approaches can be classified into one of five categories: (1) science process skills, (2) deductive or verification, (3) inductive, (4) technical skill, and (5) problem solving.

Lab work refers to the concepts of science needed to understand natural phenomena and changes made to nature through human activities. This can help to develop aspects of life skills. Life skills development can be done through education at schools (Khera & Khosla, 2010), involving the active participation of students in learning (Shahali & Halim, 2010). The main objective of lab work is to help students realize the purposes of one or more of the skills of the process and to develop their own skills, thus this laboratory work can be classified as a a science lab process. Science process skills are involved in all types of lab activities, such as observation (Sukardiyono, Sukardiyono, & Wardani, 2013). Therefore, some lab activities can be used to increase awareness and competence of the students concerned with science process skills.

One of the overviews which shows that the evaluation of science learning is put on one side is disregard of the development of science process skills. Basically, science is not only a set of knowledge of facts or concepts, but also a way of working, a way of thinking, and a way to solve the problem (Sudana, dkk., 2010). Teachers do not understand the nature of this issue and often they provide theory to students without practicing directly. This way causes the students of not having an opportunity to find out how these theories exist and are used in a real life. In addition, students also do not get a space to train their science process skills. According to Widyanto (2009), the science process skills is the ability or skill to carry out an act in the learning of science to produce concepts, theories, principles, laws and facts or evidence, while according to Ozgelen (2012) science process skills are skills used to build knowledge which can solve problems and formulate results.

Based on the results of observation which have been conducted to one of the science teachers, in SMPN 2 Tolitoli, it is found that the learning process undertaken can not stimulate the participation of the students to play an active role in learning, particularly in the development of science process skills. The cause of this condition is learning activities still using conventional learning models. Students are considered merely as a passive recipients of the information which is offered by the teachers. Teachers rarely implement any existing learning trial activities. Moreover, teachers do not understand about innovative learning. Teachers only rely on the usual lesson steps and content which are written on the sources book. Beside that, teaching and learning process at school is not supported by any media and adequate visual aids. In fact, government has distributed an educational aid . a science KIT to every school. This condition is worsened by the unavailability of laboratory, although this problem can actually be solved by using the classroom or even outdoor as a place to do lab work.

Related with that problem, one of the alternatives solution is use the device of the development of PCK which is better known as the subject specific pedagogy. To reinforce tthis opinion, Margo (2014) from minor-major English at the university of Detroit confirms that Subject Specific Pedagogy (SSP) is based on "how to learn something". It is not only what we learn, but also why and how we think it. Then, the SSP is integrated with lab work approach, so that students are able to participate actively in learning science. Based on the description above, we can conclude that it is necessary to do a research which is aimes to know about the influence of SSP science toward science process skills of the IX grade students of SMPN 2 Tolitoli in academic year 2016/2017.

METHOD

The research was conducted in SMPN 2 Tolitoli at the first semester of the academic year 2016/2017. The type of research is quasi experiment using non equivalent control group design. The technique that used to select the sample was the technique of random sampling. Before setting the experimental and control class, the researcher firstly tests the equality of all members of the population by using ANOVA. After testing and finding an equivalent result, the next process is deciding class IX-B as an experimental class implementing IPA SSP lab work-based and class IXC as the control class implementing the conventional learning ones.

The instrument in this study includes the syllabus, lesson plan and worksheets created and validated by two lecturers. Science Process Skills (SPS) are measured using observation sheets. The researcher also makes an assessment rubric indicators listed in Table 1. The subject in this study refers to material of Dynamic Electricity.

Table 1. Assessment Indicators of Science Process Skills

No.	Indicator of Science Process Skills
1	Observing
2	Making Hypothesis
3	Measuring
4	Conducting Experiment
5	Taking notes and analyzing data of the experiment
6	Communicating results of the experiment

Adapted from Chiappetta & Kobbala [30].

The data were analyzed with descriptive analysis techniques which were used to present the data of science process skills of experimental and control class which have been acquired through the observation sheets at initial and final test. Data analysis of descriptive science process skills which will be presented contains the difference of the average score, median, mode, standard of deviation, variance, and minimum score, maximum score, as well as the score of the Gain Normalized in the experimental class and control class. The learning process skills score was converted based on the *Likert* scale of 4 criteria to know the criteria. The formula can be seen in Table 2.

Table 2. Conversion Score on a scale of 4

No	Interval Score	Criteria
1	Mi + 1,5 Sdi < $\bar{X}$ ≤Mi + 3,0 SDi	Very good
2	Mi + 0 SDi < $\bar{X}$ ≤Mi + 1,5 SDi	Good
3	Mi – 1,5 SDi < $\bar{X}$ ≤Mi + 0 SDi	Fair
4	Mi –3SDi < $\bar{X}$ ≤Mi-1,5 SDi	Less

Depdiknas (2010)

Remarks:

Mi = Ideal Mean

= $\frac{1}{2}$ (maximum score + minimum score)

SDi = Ideal Deviation Standard

= $\frac{1}{6}$ (maximum score – minimum score)

$\bar{X}$ = Total of average score of empirical data

Test Normalized Gain (N-Gain) represents the difference between initial and final score which indicates increasing students' science process skills after getting trained by educators. Comparison between initial and final test score of students' science process skills can be calculated by using e formula of Normalized Gain (N Gain)/gains index. (Meltzer, 2007). The gain factor categories are presented in Table 3.

N-Gain/Gain index =$\frac{Initial\ Score\ - Final\ Score}{Maximum\ Score - Initial\ \ Score}$

Table 3. Categories of Gain factors

Gain Score	Category
g > 0,7	High
0,3≤g<0,7	Medium
g<0,3	Low

Furthermore, the technique of data analysis used inferential analysis, that is ANOVA (anlysis Of Variance) with Tukey test. Before testing the hypothesis of the data, it was previously done what is called as a prerequisite test, namely: test for normality by using the Kolmogorov-Smirnov test and homogeneity test by using Lavene's test with sig> 0.05. Further test includes Kruskal Wallis test that used when the sample is not normal.

RESULT AND DISCUSSION

In general, the result of research described in this section is about the score of the observation of science process skills at initial and final test achieved by students of SMPN 2 Tolitoli between class IXB and class IXC as the experimental group and control groups.

Initial Science Process Skills

Before the study was conducted, the first step to do is doing an observation to determine students' science process skills using observation sheets on the previous learning materials. Table 4 shows the result of observed initial science process skills of students in the experimental class and control class.

Table 4. Initial Data of Science Process Skills at SMPN 2 Tolitoli

No.	Component	Experimental Class	Control Class
1	The number of students	31	31
2	The average value of SPS	61,83	58,74
3	Maximum value	75,00	70,83
4	Minimum value	50,00	45,83
5	Variants	49,88	65,23
6	Standard of Deviation	7,06	8,08

Table 6. Data of Science Process Skills of Students in Each Meeting at SMPN 2 Tolitoli

No	Component(s)	Experimental Class			Total	Control Class			Total
		I	II	III		I	II	III	
1	Average value	78,36	81,99	84,68	81,68	61,02	63,58	65,05	63,22
2	Maximum value	87,50	91,67	95,83	91,67	79,17	79,17	95,83	84,72
3	Minimum value	50,00	66,67	66,67	61,11	45,83	45,83	45,83	45,83
4	Variants	108,12	75,68	66,42	83,41	77,02	85,61	123,47	95,37
5	Standard of Deviation	10,23	8,56	8,02	8,93	8,78	9,25	11,11	9,71

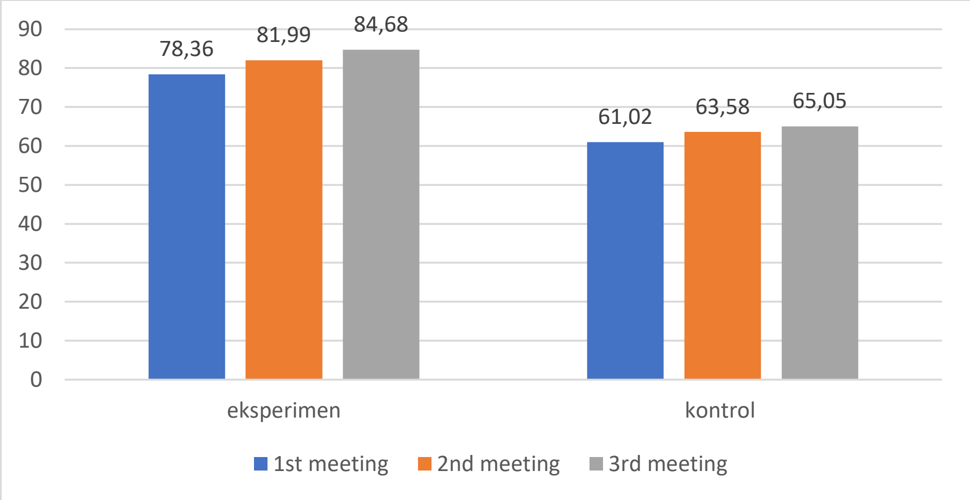

Figure 1. Histogram of Science Process Skills of Each Meeting at SMP N 2 Tolitoli

Based on the data in Table 4, we see that the average score of the initial science process skills of students in the experimental class is 61.83 and it is higher than the average score of the initial science process skills of students in the control class, that is 58.74. The initial score of science process skills gained by the students in the experimental class and control class Science Process Skills in Every meeting

Based on Table 6, at the first meeting, the average of students' science process skills score in the experimental class is 78.36 and then it is increased in the second and third meeting into 81.99 and 84.68. The average of students'science process skills in the experimental class is 81.68 which belongs to "Very Good" criteria. Meanwhile, the score of students' science process skills in control group at the first meeting shows 61.02 and it is increased in the second meeting into 63.58. A significant increase can be seen in the third meeting in which the average score of students' science process skills has risen into 65.05. So, the average score of the overall science process skills of the students is 63.22 and this point put the control class in the category of "Fair". Reviewing the standard of deviation between the two groups, the data dissemination of students in included into "Fair" category of science process skills. This is in accordance with the table of category of students' science process skills which is written in the data analysis techniques (Depdiknas, 2010). Reviewing the standard of deviation between experiment and control class, it reveals that both classes have the same wide of data distribution.

the control class is wider than the experimental class.

Figure 1 shows that the distribution of the student's sience process skills data distribution in the experimental class in three meetings suggest that learning used SSP of lab work-based in the experimental class has a higher tendency than SSP of conventional lab work-based. In the experimental class, the average of students' science proccess skill score in each meeting has increased; in the first meeting, the average of students' science process skills score is at 78.36, in the second meeting it raise into 81.99 and in the third meeting, it is at 84.68. Thus, it is obtained that the average of overall students' science process skills score in the experimental class is 81.68. Those results show that the application of students' learning process using SSP of lab work-based is able to make the process of learning run effectively. It is in line with the previous research (Indrawati, 2010), that the majority of students who go through lab work of dynamic electricity are capable to develop science process skills well. This point of view is also in accordance with the opinion of Collette & Chiapetta (1994) who state that the lab work allows students to conduct scientific investigations, make questions and predictions, do observations and organize data (Khera & Khosla, 2012) It is also confirmed that the experiment is an evident in implementing an active learning in gaining direct experiences so that students can develop a variety of psychomotor skills, cognitive and affective which actually exist in the student themselves (Subagyo, 2009).

In the control class, the average of students' science process skills score also increase in every meeting. In the first meeting the obtained score is 61.02, in the second meeting is at 63.58 and in the third meeting, the score is 65.05. These three scores bring the average result of the overall students' science process skills score into 63.22. Conversely, the increased scores in control class are not as high as in the experimental class. It can be caused of the lack optimization in learning process which involves the role of the students. Moreover, the learning process which takes place also shows that the students are less active and skill in following it. The students tend to be more silent and they do not know what they must do because of the lack of knowledge or ideas at the time when they run lab work about dynamic electricity. Initial knowledge is very important when doing something which involves skill therefore, students must be given an idea to make them more aware of what they must do. Based on the analysis of the observation result, it is concluded that root of the problem causing low process skills of the control class is due to the model applied is not yet optimal to train the right science process skills. This is confirmed by Ekene & Ifeoma (2011) who claim that the process skills should be developed through direct experience that involves a variety of materials and physical use.

The improved science process skills of the students in the experimental class and control class can be seen in Figure 4.

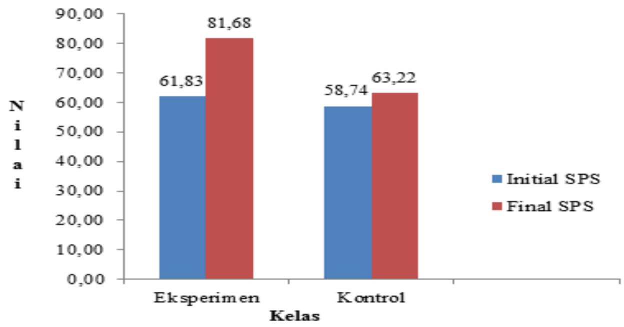

Figure 4. Histogram of Science Process Skills at SMPN 2 Tolitoli

The average of students' science proscess skills score in the experimental class is 61.83 and the average of the final science process skills score is 81.64. Meanwhile in the control class, the average of the students' science process skills score denotes 58.74 and the average of the final science process skills score denotes 63.22. The category of science process skills improvement is determined by calculating the average of Gain Normalized score. Based on the analysis of the average of the Gain Normalized score (g), the experimental class received grade as high as 0.5 which is included in the category of "medium". On the other hand the control class obtains an average of the Gain Normalized (g) score at 0.1 in which it clasified in the category of "low". Based on this result, we can conclude that the improvement of students' science process skills in the experimental class is better than the improvement of students' science process skills in the control class.

Table 6. Category of Science Process Skills Improvement at SMPN 2 Tolitoli

No	**Score**	**Class**	
		Experimental	**Control**
1	Initial SPS	61,83	58,74
2	Final SPS	81,68	63,22
3	*g*	0,5	0,1
4	Category of increase	Medium	Low

Before testing the hypothesis, prerequisite test in advance is initiated to take place where in the test of One Way Anova, prerequisite test suggested consists of normality and homogeneity tests using One Way Anova (variant of the same data). The results of Normality and homogeneity test using one way ANOVA can be identified in Table 7 below.

Table 7. Results of Normality and Homogeneity Test of One Way Anova

SPS	Kolmogorov smirnov Experimental	Control	Description	Lavene test	Description
Initial	0,129	0,170	Normal	0,224	Homogeneous
Final	0,178	0,200	Normal	0,300	Homogeneous

After completing prerequisites test, the process comes up into hypothesis test using One Way ANOVA. ANOVA test is used to determine the effect of the specific subject learning pedagogy of lab work-based toward science process skills of the students in the experimental and control class. The results of One Way Anova Test are presented in Table 8.

Table 8. Results of ANOVA Test of Science Process Skills at SMPN 2 Tolitoli

Test	*Sig.*	Conclusion
Anova	0,000	Ho rejected

Table 8 shows that the value of Sig. obtained points 0.00 and the value is less than 0.05. It means that students' science process skills are significantly affected by science learning with SSP of lab work-based. The result denotes that the application of students' learning using science SSP of lab work-based is able to create an effective learning process. This result is similar with the result of previous studies conducted by Mursito (2016), that the majority of students through lab work dynamic electricity enables to develop science process skills well. The result of research conducted by Hidayati (2012), which is explains that students' science process skillswhich is learning using lab work is higher than science process skills of students whose learning using demonstration methods. Another research also has the same result as the previous is the research by Chusni & Widodo (2013), shows that science process skills using science student worksheet (SW) of lab work-based is higher than the ones who use science worksheets provided by school. A similar result is also proposed by Collette & Chiapetta (1994), that said that lab work has five categories; one of them is developing science process skills, thus laboratory work can involve students in a variety of scientific questions which require them to ask, solve problems, make predictions, do observations, organize data, give explanations and draw patterns etc

CONCLUSION

Based on the results and discussion, it can be concluded that the science Subject Spesific Pedagogy (SSP) of lab work-based implemented into science learning under dynamic electricity material significantly influences the students' science process skills at SMPN 2 Tolitoli in which the attainment of the average of the experimental class score is on "very good" category and the possition of control class stays at "fair" category. In addition the improvement of science process skills based on the gain normalized (g) denotes that the experimental class occupies "high" category than the control class. The One Way Anova test results shows that the value of Sig. is 0.00. because the score is less than 0.05, it means that students' science process skills are significantly affected by science SSP of Lab work –based.

Some suggestions based on this study are (1) Teacher should be able to be innovative and creative in presenting learning materials to the students, such as by linking it with the problems which is near with the students, so that the students' learning process will be more challenging as they need to find out any additional information by themselves and they can be active in the learning process; (2) it is expected that the headmaster encourage the teachers to use the SSP lab work-based during the teaching and learning process, especially to improve students' science process skills; (3) for other researchers who want to conduct more research regarding SSP of lab work-based in a wider scope, this research can be used as a reference for a betterment and improvement to the upcoming research.

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