JPII 7 (1) (2018) 85-95

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

EFFECTIVENESS OF POGIL WITH SSI CONTEXT ON VOCATIONAL HIGH SCHOOL STUDENTS' CHEMISTRY LEARNING MOTIVATION

I. B. Yuliastini*[1], S. Rahayu[2], F. Fajaroh[3], N. Mansour[4]

[1]Public Vocational High School 9, Malang, Indonesia
[2,3]Chemistry Department, Universitas Negeri Malang, Indonesia
[4]Graduate School of Education, University of Exeter, UK

DOI: 10.15294/jpii.v7i1.9928

Accepted: November 4th, 2017. Approved: February 21st, 2018. Published: March 19th, 2018

ABSTRACT

This study aimed to examine the difference of Vocational High School students' learning motivation after they were taught the topic of the electrolyte solution and redox reaction using POGIL model with SSI context, POGIL, and conventional learning. The research design used was quasi-experiment with the model of pre-test and post-test control group design. The research subjects were three classes with the similar initial ability. The data were obtained using SMTSL motivation questionnaire (r = 0.824) and analyzed using ANCOVA. The research results showed a significant difference in learning motivation between students taught using POGIL with SSI context, POGIL, and conventional learning. The students who were taught using POGIL with SSI context had the highest learning motivation compared to those taught using POGIL and conventional learning.

Keywords: POGIL, SSI, learning motivation

INTRODUCTION

Chemistry is one of the subjects taught in Vocational High School (VHS). One of the goals of chemistry learning in VHS which is in accordance with curriculum 2013 stated that the students could understand the concept, principle, law, and theory of chemistry; their connectivity and implementation also can solve the problems in daily life, the technology; and the students have basic competency as the basis for developing the competency in each expertise field. Correspon-ding to such purposes, the chemistry learning in VHS demands the students' mastery of basic concepts of knowledge in which the process and domain must support the development of skill in fulfillment of the productive expertise program. In the structure of curriculum 2013 for expertise program of technology and engineering in Vocational High School, chemistry is the part of the subjects of the expertise field basic devotee group (C1). Chemistry is a subject of bonding substance on the basis of expertise field of Technology and Engineering group so that it is very significant for VHS students to understand the topics of chemistry. Moreover, nowadays, chemistry, as the center of science, is one of the sciences underlying the science, technology, and industry (Chang, 2011). Besides, according to Oloruntegbe & Alake (2010), chemistry is a knowledge needed by the students to solve the problems in daily life.

Although the chemistry subject is important, the reality in school shows that most of VHS students dislike the chemistry subject since many of its topics are difficult (Sitepu, 2016; Refriwati, 2015). This case indicates that VHS students' learning motivation is still low. The cause of the low motivation is, for example, generally, the chemistry learning is emphasized on only the con-

*Correspondence Address:
E-mail: ikaby.smkn9@gmail.com

cept mastery without showing the relationship between concepts learned by implementing them in the daily life (Holbrook, 2005).The lack of information of the relevance of chemistry in the daily life including its relationship with the productive subject is also problematic for students in learning chemistry so that it causes the students' low interest and motivation to study chemistry (Aikenhead, 2003; Price & Hill, 2004). Whereas, there are so many phenomena in the life related to chemistry. For example, in motorcycle automotive engineering, the phenomenon of fuel combustion, corrosion of motorcycle components, work performance of battery/accumulator of the motorcycle, and welding or metal connecting includes chemical reaction.

Another factor that also causes the low motivation of chemistry learning in VHS is the chemistry learning tends to be teacher-centered so far, that is the teacher often employs expository learning model (speech) in which the learning process less includes the students' role; the teacher still dominates the learning process. In expository learning, the teacher transfers the knowledge to the students while the students only listen to and pay attention to the teacher's explanation. This case is in line with the research results of Koulougliotis & Salta (2012) stating that the low motivation in chemistry subject is caused by the application of teacher's learning strategy which is less interesting and involving the students' role.

In learning activity, motivation has a significant role. The students who have high motivation will be actively involved in the learning process and try to learn diligently, feel happy and optimistic in accomplishing the tasks given by the teacher. On the other hand, the students whose learning motivation is low do not attempt hardly to learn. In agreement with the statement of Bereby-Meyer & Kaplan (2005), the factor of motivation plays an essential role in students' learning and strategy transferring of problem-solving. This finding is also supported by the research results of Sevinc et al.(2011) showing that the students with high academic achievement also have high motivation level.

Tuan et al. (2005) addressed that there are six factors which influence learning motivation as stated in SMTSL questionnaire as the indicator of motivation namely: self-efficacy, students' active learning strategies, science learning value, performance goal, the achievement goal, and learning environment stimulation. The followings are the explanations of each indicator of learning motivation: (1) Self-efficacy is students' confidence in their ability to do the learning tasks well; (2) Students' active learning strategy means that the students take an active role in using any techniques and strategies to build new knowledge based on their previous understanding; (3) Science learning value is letting the students attain the competency of problem-solving and investigate, stimulate their thought and find the relevance of knowledge learned in daily life. If they can feel the principal values of something they learn, they will be motivated to further learn science and knowledge; (4) Performance goal is the student's goal in science learning including competing with the other students to get the teacher's attention; (5) Achievement goal, in this case, the students feel satisfied because they can improve their competency and achievement during the learning; (6) Learning environment stimulation includes the environment in the class, around the students, such as curriculum and interaction between student and teacher and student-student as well as motivation in learning the science and knowledge.

Motivation is a significant pre-requirement and core to learn. Initially, motivation is required to make the students are willing to participate in learning, and then the motivation is needed during the learning process (Rahayu, 2015). The process of the raising of individual's learning motivation is divided into two types namely intrinsic and extrinsic motivations. Intrinsic motivation is the motivation that arises in someone's self, and it is a human's natural tendency to look for and solve the challenge supporting the passion and ability (Woolfoolk, 2010). When someone is intrinsically motivated, he/she does not need incentive or punishment since the activity is interesting and beneficial. Extrinsic motivation is the motivation arising due to the external stimulation. When someone does something to get a reward, avoid the punishment, please the teacher or the other reasons, it can be said that the individual does the academic activity because of extrinsic motivation. Rannikmäe and Holbrook (2009) mentioned that the students' intrinsic motivation could be enhanced by making the science learning interesting and relevant to the students.

One of the learning models involving students' active role is POGIL (Process oriented guided inquiry learning) with SSI context. According to Hanson (2006), POGIL is an inquiry learning oriented to the process and centered on the students in active learning using cooperative learning and guided inquiry to develop the knowledge, the question to improve individual's critical and analytical thinking skills, problem-solving skills, metacognition skills, and responsibility. Learning with POGIL model emphasizes two aspects namely learning topic and learning process (Hanson, 2006; Moog et al., 2009; Straumanis, 2010). The goal of learning using POGIL is to increase the learning process and guide the students to have a conceptual understanding of the topic being learned (Moog & Spencer, 2008). The steps of POGIL include five stages (Hanson, 2005) namely: orientation, exploration, concept formation, application, and closing.

POGIL has three principal components, namely cooperative learning, guided inquiry, and metacognition. Cooperative learning provides a competitive learning environment in which the students will learn and understand better as well as remember more things when they work cooperatively (Hanson, 2005). The guided inquiry learning in POGIL is by involving the students actively and encourage them to restructure their information and knowledge by using a learning cycle consisting of five stages namely orientation, exploration, concept formation, application, and closing/conclusion (Hanson, 2005). POGIL also demands the students to utilize metacognition so that they are aware that they must be responsible for their learning, they need to reflect what they have learned and what they have not understood. Straumanis (2010) explained the benefits of POGIL that is the students can process the information, think critically, solve the problem, communicate, be cooperative in teamwork, manage, and do self-assessment.

Some research results of the effectiveness of the use of POGIL in the chemistry learning are such as the research results of Sen & Yilmas (2015)exhibiting that the students were more interested in and enjoyable with the chemistry learning using POGIL. Yalcinkaya & Erdur-Baker (2012) asserted that the learning involving the solving of the problem in the real world through group teamwork could improve the students' self-efficacy and learning motivation.Widyaningsih et al. (2012) based on the research result mentioned that through POGIL, most of the students actively and critically thought in the class or laboratory. Maulidiawati (2014) concluded that cooperative learning using POGIL was effective in students' learning outcome for the topic of solubility and the multiple results of solubility as well as it could improve the students' learning motivation.

Based on the research results of POGIL above, it can be concluded that POGIL can improve student's learning motivation. However, to support the implementation of POGIL model and to make it more interesting and the students' learning motivation enhances by using learning context which is relevant to the daily life. One of the contexts that can be used in POGIL is SSI (socio-scientific issues).Learning with SSI context is a learning approach that studies the facts, phenomena, or occurrences based on the social issues related to science in the society(Ratcliffe & Grace, 2003). POGIL with SSI context performs the problems that are close and relevant to the students' life. The solving of these contextual problems is then searched through active discussion done by the students and their friends in a group. SSI involves the use of topic or scientific problems that obligate the students to be involved in the dialogue, discussion, and debate. The problems presented in SSI are controversial in nature, but they have additional elements that need moral reasoning level or evaluation of ethic problem in the process of decision making about the possibility of issues-solving (Zeidler & Nichols, 2009).

The implementation of POGIL model with SSI context in learning can help the teachers to ensure all students are actively involved in the learning process with the role performed by each student; the learning team in POGIL consists of four people who have a role. This case is in accordance with the statement of Moog et al. (2009) that giving the role to each student could improve the student's involvement by giving special responsibility and helping the students to develop any skills related to each role. The students' main role as the member of a group is active involvement in the group discussion. According to Moog et al. (2009) & Straumanis (2010), besides the main role, the students also get special roles such as being a manager (assuring that all group members perform their role), presenter (presenting the report verbally), recorder (recording the results of group discussion), and reflector (observing and giving comment about the group dynamic). Besides, by discussing SSI cases, the students will be more interested in learning since the things being discussed are related to the daily life-problems that they have known so that their passion and motivation to learn chemistry increase.Rahayu (2016) stated that the cases that are relevant and familiar to the students would visualize the abstract concepts well to make them more concrete and the students can apply their understanding in SSI debate. Besides, SSI is potential to minimize the problem regarding class management and provide the problem-solving as well as the students' opportunity to better understand the topic of chemistry (Rahayu, 2016).

Electrolyte solution and redox reaction are the topics of chemistry taught to the Vocational High School students of class X for the program of Technology and Engineering expertise. Both topics are the basic topics required to learn electrochemistry. The characteristic of the electrolyte solution and redox reaction topics is many of them which are abstract. For instance, in the electrolyte solution topic, the students could not explicitly observe ions moving freely in the electrolyte solution so that it caused the electrolyte solution could conduct the electrical charge. In redox reaction topic, the students also could not directly observe the occurrence of oxygen release and acceptance, or the process of giving and receiving an electron from certain atom to another atom. Due to this abstract characteristic of the topic, the students are hard to learn the electrolyte solution and redox reaction topics.

Some research results present the difficulties in the electrolyte solution, and redox reaction topics such asGarnett & Treagust (1992) reported that some students were confused about the characteristics of electrical current in the metal conductor and an electrolyte solution. Furthermore, Garnett &Treagust (1992) mentioned that redox reaction is a difficult topic to be understood since it includes abstract topics so that the students were hard even wrong in learning the redox reaction topic. Soudani et al. (2000) found that the students faced difficulty in using theoretical knowledge of redox to interpret the daily phenomena. The students' difficulty in learning electrolyte solution and redox reaction theories caused the students were less interested in chemistry subject, and their learning motivation was low.

Based on the characteristics and problems of chemistry learning in VHS that have been explained before, to overcome the low motivation of VHS students in chemistry learning especially in electrolyte solution and redox reaction topics is by applying the learning model that involves the students in learning process and using learning context related to the daily phenomena or in accordance with the expertise competency that is by using POGIL with SSI context. Therefore, this work aimed to test whether there is a difference in learning motivation of VHS students taught using POGIL with SSI context, POGIL, and conventional learning and testing the effectiveness of POGIL with SSI context on VHS students' learning motivation.

METHODS

This research used a quasi-experimental design with pre-test - post-test control group design. The subjects of this research were the students of class X in the State Vocational High School 9 of Malang for the expertise competency of Motorcycle Engineering (ME) academic year of 2016/2017 consisting of three classes with similar initial ability. The experiment 1, experiment 2 and control classes were determined by lottery so that class X of Motorcycle Engineering 2 was chosen as the experiment 1 class that would be taught using POGIL with SSI context, class X of Honda Motorcycle Engineering as the experiment 2 class that would be taught using POGIL and class X of Motorcycle Engineering 1 as the control class that would be taught using conventional learning. This research design is shown in table 1.

Table 1. Scheme of Research Design

Group	Pre-test	Treatment	Post-test
Experiment 1	O	X_1	O
Experiment 2	O	X_2	O
Control	O	-	O

(Adapted from Creswell, 2012)

Note:
O : Observation (pre-test and post-test of learning motivation)
X_1 : Learning using POGIL with SSI context
X_2 : Learning using POGIL

Before conducting the research, the researchers proposed permit to the head of Education Department of Malang City. Moreover, the Education Department of Malang City recommended the State Vocational High School 9 of Malang in order the researchers were permitted to research the State Vocational High School 9 of Malang. By the recommendation from the Education Department of Malang City, the researchers asked for permission to the headmaster of the State Vocational High School 9 of Malang. After attaining a permit from the headmaster, the researchers called the chemistry teacher teaching in class X of Motorcycle Engineering and asked for permission to involve the students of class X of Motorcycle Engineering as the research subject. The students in experiment 1 and two classes were given an explanation of POGIL model that would be implemented in the learning of electrolyte solution and redox reaction topics.

Instruments used in this research consisted of two types namely treatment instrument and measurement instrument. Treatment instrument was utilized in the learning process in experiment 1 and two as well as control classes, and it consisted of the syllabus, lesson plan, and Student Worksheet of the electrolyte solution and redox reaction topics. The treatment instruments in the three classes used as the research subjects were different in accordance with the applied learning model. Before using the instrument to collect the data, all treatment instruments were validated by three experts namely two chemistry lecturers of the State University of Malang and one chemistry teacher of Vocational High School. The results of expert validation showed that all treatment instruments were categorized valid and feasible to be employed as a research instrument.

Measurement instrument was in the form of learning motivation questionnaire used to measure the students' motivation in chemistry learning in experiment 1, experiment 2, and control classes. The motivation questionnaire used in this research was adapted from the motivation questionnaire developed by Tuanet al. (2005) which is Student's Motivation Toward Science Learning (SMTSL) Questionnaire consisting 35 items; each question item has five answer-choices, they are: extremely disagree, disagree, doubt/abstain, agree, extremely agree. Learning motivation measured using SMTLS questionnaire refers to six aspects namely self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation.

Before using the instrument of motivation questionnaire to collect the data, this instrument was validated by two chemistry lecturers from UM and one chemistry teacher from VHS. The results of validity test of the content of motivation questionnaire exhibited a very high value of validity (validity = 91%). The results of the trial test of learning motivation questionnaire indicated that all options in that questionnaire are categorized as valid, and the test reliability had the value of alpha = 0.824. The reliability score of the research instruments is categorized as very high so that it is feasible to be used as research instrument.

The data collection in this research was conducted in 12 meetings. The researchers became the teacher doing learning treatment, giving the test, and collecting the data of the results of treatment and measurement. The data attained from the results of the questionnaire of students' learning motivation was descriptively analyzed to know the percentage of students' learning motivation for each criterion (high, moderate, low). Subsequently, the statistical analysis was done using covariant analysis (ANCOVA) with the score of pre-test as the covariate to test whether there was a difference in learning motivation of students in experiment 1, experiment 2, and control classes.

The following table 2 is the example of stages of POGIL with SSI context as well as the activities of students and teacher in learning the electrolyte solution topic.

Table 2. Stage of POGIL with SSI Context

No	Stage of POGIL with SSI Context	Students' Learning Activity	Teacher's Help
1.	Problem orientation with SSI	• Observing picture or video of people looking for fish using electrical current. • Writing and formulating inference based on the picture or video presented by the teacher. • Determining a question that will be investigated further.	• Displaying video by asking the students to make inference • Directing the students to make the questions that will be investigated.

2.	Problem exploration based on the SSI context	• Forming group in conformity with the teacher's briefing • Sharing role with the group members (manager, presenter, recorder, and reflector) • Conducting exploration activity based on the guideline in the Student Worksheet. This exploration activity can be experiment or literary study	• Dividing the students into groups • Explaining the rule of group discussion fitting with each student's role • Guiding the students to explore, experiment, and accomplish the Student Worksheet
3.	Concept formation	• Reporting the results of group exploration in front of the class to form the learned topic concept • Self-construction of topic concept with the briefing of questions in the Student Worksheet	• Asking the students to discuss the results of group exploration • Guiding the discussion activity • Reinforcing the concept
4.	Application through discussion of SSI case	• Analyzing article of SSI through discussion activity with the group members • The student representation explains the analysis results of given SSI problems	• Presenting article of SSI and asking the students to discuss it in the group • Pointing presenter from some groups to present the results of group discussion
5.	Closing	• Driving a conclusion of topic that has been learned • Reflecting the learning experience and obtained knowledge (self-assessment)	• Guiding the students to drive a conclusion • Guiding the students to do reflection

The SSI cases utilized in learning the electrolyte solution topic are such as: (1) *The dilemma of the use of a stunning tool to catch fish.*These SSI cases were related to the topic of solution conductivity in which the students were given a certain article of fishing by using electrical current causing the fishes are easy to find, but in another side, the use of this electrical current can damage the environment ecosystem. In this case, the students were expected to be able to identify why the fishes could die if people fished by stunning and how did the students respond the way of finding fishes by using electrical current; (2) *Battery: advantage and danger.*For this case, various types of battery and its chemical reaction were presented. Based on the chemical reaction-reaction presented by students, they were expected to be able to identify the compound of electrolyte substance of the battery. Besides, the students were also involved in the debate of advantage and danger of the battery. Through this debate, the students were actively engaged in learning.

The SSI cases employed in redox reaction topic learning are such as: (1) *Motorcycle and car cause the biggest carbon emission in Indonesia.* In this case, the reactions in fuel combustion process were presented in which most of the gases resulted contribute to the air pollution. Through the chemical reactions in the fuel combustion process presented, the students were expected to able to determine the type of oxidation and reduction reactions based on the oxygen bonding and releasing; (2) *Hydrogen Fuel Cell: Indonesian Future Energy.* Hydrogen fuel cell is a future energy source that has eco-energy with the combustion process that only results in water and energy (electricity and heat). However, the use of this fuel cell also raises the debate because it turns out that the result of the reaction of hydrogen and oxygen is not only water, but UV ray becomes its side product, and explosion risk are very vulnerable to the usage. In this case, the example of chemical reaction occurring in a fuel cell was also presented so that the students were expected to be able to understand the oxidation and reduction reactions based on the electron releasing and receiving; (3) *Cigarette and Its Danger*. In these SSI cases, the substances containing cigarette were presented so that the students were expected to be able to identify and determine the number of oxidation of elements containing a cigarette; (4) *Corrosion is occurring to the motorcycle bars due to the scratch of zinc layer.* The corrosion happening to the motorcycle bars because of the scratch of zinc layer is a case which is very relevant to the students of

VHS, Motorcycle Engineering Department. By presenting this case, the learning was expected more interesting, and the students could understand the oxidation-reduction reactions based on the change of the number of oxidation; (5) *Chemical substance in clothing whitener.* Clothing whitener is an example of redox reaction application in daily life. The clothing whitener is the process of chemical reaction in which the dirty molecules will be broken into smaller parts so that it is easier to be lifted by surfactant (stain lifter). Whitener solution sold in the market usually contains active material of sodium hypochlorite in which the production process of NaOCl involves the autoredox reaction. By presenting this case, the students were expected to be able to understand the autoredox reaction.

By presenting such above examples of daily cases which are relevant to the electrolyte solution and redox reaction, the students were expected to be more interested in chemistry learning, and VHS students' learning motivation could increase. The followings are the examples of SSI presented in redox reaction topic learning.

RESULTS AND DISCUSSION

The results of a students' learning motivation questionnaire given before and after they learned electrolyte solution and redox reaction were then tabulated and descriptively analyzed to obtain the data of the percentage of students' motivation based on the criteria presented in table 3.

Table 3. Percentage of Students' Learning Motivation Based on the Criteria

CLASS	Criteria of Motivation	Pre-test (%)	Post-test (%)
	High	-	79
Experiment 1	Moderate	76	21
	Low	24	-
	High	-	60
Experiment 2	Moderate	80	36
	Low	20	4
	High	-	7
Control	Moderate	75	75
	Low	25	18

Based on the data presented in table 3, there was an improvement of students' learning motivation indicated by the increase in students who had high and moderate motivation and the decrease in the students who had low motivation at the end of learning. The data of pre-test and post-test scores of students' learning motivation questionnaire are presented in table 4.

Table 4. Mean of Pre-Test and Post-Test of Students' Learning Motivation

CLAS	Mean of Pre-Test	Mean of Post-Test	Gain Score
Experiment 1	89.59	135.48	45.90
Experiment 2	89.68	128.48	38.80
Control	89.61	102.61	13.00

Table 4 shows that there was an increase in scores of the students' learning motivation in experiment 1, experiment 2, and control classes. This case means the students' learning motivation changed after the learning process of the electrolyte solution and redox reaction. Before doing a hypothesis test to the scores of the students' learning motivation, the analysis pre-requirement test was conducted in the form of normality and homogeneity tests. Normality test of the scores of students' learning motivation in experiment 1, experiment 2, and control classes was carried out using One-Sample Kolmogorov-Smirnov Test in the trust level of 95% (α = 0.05) assisted by IBM SPSS Statistics 20 for Windows program.The results of normality test for the three classes are presented in table 5.

Table 5. Results of Normality Test of Students' Learning Motivation

CLASS		Experiment 1	Experiment 2	Control
N		29	25	28
Pre-test	Mean	89.59	89.68	89.61
	Std. Dev	6.080	5.475	6.652
	Sig (2-tailed)	0.200	0.200	0.200
Post-test	Mean	135.48	128.48	102.61
	Std. Dev	8.704	15.822	13.209
	Sig (2-tailed)	0.200	0.200	0.200

Based on table 5, the significant values of pre-test and post-test of the students' learning motivation in experiment 1, experiment 2, and control classes were more than 0.05 and thereby it can be concluded that the scores of pre-test and post-test of students' learning motivation in the three classes were normally distributed. The homogeneity test of the scores of pre-test and post-test of the students' learning motivation was done through Levene's test at the trust level of 95% (α = 0,05). The homogeneity test of the pre-test scores of the students' learning motivation in the three classes resulted in a significant value of0.082. The significant values of pre-test and post-test were higher than 0.05, and thus it can be concluded that the scores of pre-test and post-test on the students' learning motivation in experiment 1, experiment 2, control classes had the similar or homogenous variant.

Hypothesis test on the students' motivation was conducted using ANCOVA at the trust level of 95% (α = 0.05) assisted by IBM SPSS Statistics 20 for Windows program. The ANCOVA test of the scores of students' learning motivation in the three classes resulted in significant value for the learning model of 0.00 (Sig < 0.05). This case means that there was a significant difference in learning motivation of students taught using POGIL with SSI context in experiment 1 class, POGIL model in experiment 2 class, and conventional model in control class.

To test the calculation results of the three research classes, the further test of Post Hoc was conducted using LSD test to obtain the data of classes which had a real difference. The results of Post Hoc test for the effect of learning model on the students' learning motivation are presented in table 6 as follows.

Table 6. Results of LSD Post Hoc Test of the Effect of Learning Model on the Students' Learning Motivation

Dependent Variable	(I) Model	(J) Model	Mean Difference (I-J)	Sig.
Students' learning motivation	POGIL+SSI	POGIL	7.00*	0.048
		Conventional	32.88*	0.000
	POGIL	Conventional	25.87*	0.000

Based on table 6, there was a significant difference in the learning motivation between the students taught using POGIL with SSI context and those taught using POGIL and conventional model (Sig. < 0.05) and there was a significant difference in learning motivation between the students taught using POGIL model and those taught using conventional model (Sig. < 0.05). Table 6 also shows that the students in the class using POGIL with SSI context had the highest learning motivation compared to those in POGIL and conventional classes.

To know the meaningfulness behind the difference in students' learning motivation, the test of effect size was conducted on the average scores of each aspect of the students' learning motivation measured. The scores of effect size for each aspect of the students' learning motivation are presented in Table 7 as follows.

Table 7. Effect Size Scores of Each Aspect of Learning Motivation

No	Motivation Aspect	A		B		C	
		Effect Size	Criteria	Effect Size	Criteria	Effect Size	Criteria
1	Personal effetciveness	1.72	Big	1.30	Big	0.29	Small
2	Active learning strategy	12.63	Big	1.76	Big	0.29	Small
3	Science learning value	1.88	Big	1.19	Big	0.55	Moderate
4	Performance goal	1.32	Moderate	1.29	Big	0.20	Small
5	Achievement goal	1.79	Big	1.18	Big	0.22	Small
6	Learning Environment Stimulation	1.96	Big	1.52	Big	0.57	Moderate

Notes:
A = Effect Size of Experiment 1 and control classes
B = Effect Size of Experiment 2 and control classes
C = Effect Size of Experiment 1 and Experiment 2 classes

The research results using ANCOVA test of the scores of pre-test and post-test of student's learning motivation showed that there was a significant difference in learning motivation of the students taught using POGIL with SSI context, POGIL, and conventional learning. Table 4 provides the information that the average scores of the students' learning motivation in the three classes increased after the learning process. The mean of post-test of the students' learning motivation in POGIL with SSI context was the highest one compared to the mean of post-test of POGIL and conventional classes.These results were supported by the results of Post Hoc test using LSD test exhibiting that the learning motivation in the class of POGIL with SSI context was the highest than that in POGIL class (the different value of mean = 7.00) and conventional class (the different value of mean = 32.88). The students' learning motivation in POGIL class was higher than that in conventional class (the different value of mean= 25.87).

Based on table 3, when pre-test was conducted, no one of all students in the three classes who had high motivation. After the treatment, the students had high motivation in the class of POGIL with SSI context, POGIL, and conventional with the value of 79%, 60%, and 7%, respectively. Meanwhile, the students who had moderate motivation in the class of POGIL with SSI context, POGIL, and conventional obtained the value of 21%, 36%, and 75%. The students with the low motivation in POGIL and conventional classes reached the value of 4% and 18%, respectively, while in the class of POGIL with SSI context, there was no student who had low motivation after learning process.

Based on the data presented before, it can be concluded that POGIL with SSI context was more effective to improve the students' learning motivation compared to POGIL and conventional learning. This case was caused by some factors. First, POGIL is learning which is oriented on the learning process. The steps in POGIL directed the students to be more active in finding the concept inductively and independently. The students' activeness could be seen in learning activity showing the high learning motivation.

Second, there was a cooperative learning component in POGIL. In the cooperative group of this POGIL class, there was a role sharing for each member to make the learning more interesting and raising the positive interaction between the group members. Learning with a cooperative group can improve confidence, ability to make an asocial relationship by enhancing confidence and teamwork ability of the group members. Hanson (2005) addressed that cooperative learning in POGIL provides a competitive learning environment in which the students could learn better, understand more things, and remember many more things when they work cooperatively.

Third, POGIL with SSI context involves controversial scientific-social issues that should be solved in the group discussion. The presented scientific-social issues are contextual and relevant to the students' life; the relevance of chemistry learning to the real world could enhance the students' learning motivation. The results of observation done by researcher indicated that in the discussion of SSI, the students were more interested in learning since each group competed to give their opinion on the controversial issues presented. These controversial issues made the discussion process more powerful. Furthermore, the topics discussed were daily problems that had been familiar to students. It was different from what happened in a group discussion in POGIL and conventional classes because the discussion topic was about the application and accomplishment of questions related to the obtained concept. Rannikmäe & Holbrook (2009) asserted that the students' intrinsic motivation could be upgraded by making the science learning interesting and relevant to them.

The results of effect size analysis on the aspects of students' learning motivation as presented in Table 6 showed that POGIL with SSI context and POGIL greatly influenced all aspects of learning motivation measured, namely personal effectiveness, active learning strategy, science learning value, performance goal, achievement goal, and learning environment stimulation. This case is because in POGIL with SSI context and POGIL classes, the students were actively involved in the learning, the SSI cases presentation enabled the students knew the relevance and value of the topic being learned to the daily life through discussion in competitive and cooperative group to increase the students' goal of getting the achievement and performance. Besides, the reflection in the closing stage could train the students' metacognitive skill to evaluate their learning outcome. Bransford et al. (2000) stated that in POGIL, the students were demanded to use metacognition in order the students realize that they should be responsible for their learning and they have to monitor their learning achievement (self-management and self-regulation); the students should reflect the topic they have not understood (reflection in learning), and they have to think of their performance and how to improve it (self-assessment).

The use of SSI as the learning context in POGIL gave moderate effect on the personal effectiveness, science learning value, and learning environment stimulation. This case is because in POGIL with SSI context, the teacher presented a case which was relevant to the topic that would be learned to enable the students to know that there was a relationship of the topic they would learn with the phenomena in life so that the students knew the meaning of learning in life. In the application step, the teacher presented an article of SSI which was pertinent to the topic of group discussion. The presentation of SSI case could improve the students' motivation to learn. In the aspect of active learning strategy, performance goal, and achievement goal, SSI context brought about small influence. This case is because in POGIL with SSI context and POGIL class, the students were guided to be actively involved in the learning so that they could construct their knowledge by themselves through competitive group discussion. The finding of this research is in line with the previous research conducted by such as Bilgin (2009), Geiger (2010); Sen & Yilmas (2015) reporting that the students were more interested in and happier in chemistry learning using POGIL. Yalcinkaya & Erdur-Baker (2012) stated that the learning that could involve solving skill of problems in the real world could enhance the students' self-efficacy and learning motivation.

CONCLUSION

Based on the explanation in this research, it can be concluded that there was a significant difference in learning motivation of VHS students taught using POGIL with SSI context, POGIL, and conventional learning. POGIL with SSI context was the most effective model to improve the VHS students' learning motivation proven by the students' highest learning motivation compared to that in POGIL and conventional learning classes.

REFERENCES

Aikenhead, G.S. (2003). Chemistry and Phisics Instruction: Integration, Ideologies, and Choises. *Chemical Education: Research and Practice*, *4*(2), 115-130

Bereby-Meyer, Y., Kaplan, A. (2005).Motivational Influences on Transfer of Problem-Solving Strategies.*Contemporary Educational Psychology*, *30*(1), 1-22

Bilgin, M. (2009).The Effect of Guided Inquiry Instruction Incorporating a Cooperative Learning Approach on University Student' Achievement of Acid and Base Concept and Attitude Toward Guided Inquiry Instruction.*Academic Journal Scientific Research and Essay, 4*(10), 1038-1046.

Bransford, J.D., Brown, A.L., Cocking, R.R., Donovan, M.S., Bransford & Pellegrino, J.W. (Eds). (2000). *How People Learn: Brain, Mind, Experience and School: Expanded Edition.* Washington, D.C: National Academy Press.

Chang, R. & Overby, J. (2011).*General Chemistry The Essential Concepts Sixth Edition.* New York: Mc. Graw-Hill.

Creswell, J.E. (2012).*Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research, Fourth Edition*. Boston: Pearson Education, Inc.

Garnett, P.J., Treagust, D.F. (1992). Conceptual Difficulties Experienced by Senior High School Students of Electrochemistry: Electrochemical (Galvanic) and Electrolytic Cells. *Journal of Research in Science Teaching*, *29*(10), 1079-1099

Geiger, M. (2010). Implementing POGIL in Allied Health Chemistry Courses: Insight from Process Education.*International Journal of Process Education*, *2*(2), 19-34

Hanson, D.M. (2005).*Designing Process-Oriented Guided-Inquiry Activities*. Listle, IL: Pacific Crest

Hanson, D.M. (2006). *Instructor's Guide to Process Oriented Guided Inquiry Learning*. Listle, IL: Pacific Crest.

Holbrook, J. (2005). *Making Chemistry Teaching Relevant*, 6(1), 1-12.

Koulougliotis, D. & Salta, K. (2012).*Student's Motivation to Learn Chemistry: The Greek Case. New Perspectives in Education*. Greece: Technologycal Educational Institute (TEI) of Ionian Island.

Maulidiawati, S. (2014). The Effectivity of Cooperative with POGIL Instruction on Learning Achievement.*Journal Unnes: Chemistry in Education, 3*(2), 163-169

Moog, R.S., & Spencer, J.N. (2008).*POGIL: An Overview*. Washington DC: Oxford University Press.

Moog, R.S., Creegan, F.J., Hanson, D.M., Spencer, J.N., Straumanis, A.R. (2009). *Process-Oriented Guided Inquiry Learning: POGIL and the POGIL Project.*(Online), (http://www.pogil.org), accessed on 16 July 2015.

Oloruntegbe, K.O. & Alake, E.M. (2010). Chemistry for Today and The Future: Sustainability Through Virile Problem Based Chemistry Curriculum. *Australian Journal of Basic and Applied Science*, *4*(5), 800-807.

Price, W.S & Hill, J.O. (2004).Raising Status of Chemistry Education.*Chemistry Education*, (8), 13-20.

Rahayu, S.(2015).Evaluating the affective dimension in chemistry education, in Affective Dimensions in Chemistry Education. In Murat Kahveci & Marykay Orgill (Eds). *Affective Dimensions in Chemistry Education*.Nederland: Springer, pp. 29–49.

Rahayu, S. (2016). *Improving Indonesian Children Scientific Literacy through Nature of Science (NOS) Oriented Instruction. Book of InnauguralSpeech of Mathematics & Science Presented, Presented at open session Senate of Universitas Negeri Malang.* Malang, 17 March 2016.

Rahayu, S. (2016). Improving Student's Higher Order Thinking Skill through Chemistry Instruction with Socioscientific Issues (SSI) and *Nature of Science* (*NOS*). *Proceding of National Seminar in Chemistry and Its Instruction.* Malang:Chemistry Departement Universitas Negeri Malang, pp. 11-19

Rannikmae, M &Holbrook, J. (2009).The Meaning of Scientific Literacy.*International Journal of Environmental & Science Education, 4*(3), 275-288.

Ratcliffe, M. & Grace, M. (2003).*Science Education for Citizenship: Teaching Socio-Scientific Issues*. Philadelphia: Open University Press.

Refriwati. (2015). Improvement Students' Learning Motivation using Problem–Based Learning Approach on Chemistry Topic of TSM Grade 11 SMKN 1 Bukit Sundi Kabupaten Solok.*Jurnal Educatio, Jurnal Pendidikan Indonesia, 1*(1), 36-42.

Sen, S. & Yilmas, A. (2015). The Effects of Process Oriented Guided Inquiry Learning Environment on Students' Self-regulated Learning Skills. *Problem in Education of 21th Century*, *66*, 54-66.

Sevinc, B., Ozmen, H., & Yigit, N. (2011). Investigation of Primary Students' Motivation Levels towards Science Learning. *Science Education International, 22*(3), 218-232

Sitepu, C.P.K. (2016).The Effect of Chemsketh Media in Instruction used Recitation Method on Chemistry Achievement and Motivation at Vocational School Grade XI. *Scientific Journal "Integritas"*, *2*(1), 1-19.

Soudani, M., Sivade,A., Cros,D., Medimagh, M.S. (2000). Transfering Knowledge from the Classroom to the Real World: Redox Reaction. *Journal of Technology Education*, *24*(1), 2-17

Straumanis, A. (2010).*Classroom Implementation of Process Oriented Guided Inquiry Learning. A practical guide for instructors.* Stony Brook University: Pacifi'c Crest.

Tuan, H., Chin,C., Shieh, S.H. (2005). The Development of a Questionnaire to Measure Students' Motivation Towards Science Learning. *International Journal of Science Education*, *27*(6), 639-654

Widyaningsih, S.Y., Haryono, Saputro, S. (2012). Model of MFI and POGIL Viewed from Learning Activities and Student Creativity to Learning Achievement. *InquiriJournal, 1*(3), 266-275.

Woolfolk,A. (2010). *Educational Psychology 11thEd*. USA: Pearson Education, Inc

Yalcinkaya, E., Boz, Y., Baker, O.E. (2012). Is case-based instruction effective in enchanging high school students' motivation toward chemistry? *Science Education International*, *23*(2), 102-116

Zeidler, D.L., Nichols, B.H. (2009). Socioscientific Issues: Theory and Practice. *Journal of Elementary Science Education*, *21*(2), 49-58.