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Improving Student's Scientific Literacy Skill Through POGIL with Socioscientific Issues Context on the Topic Enviromental Pollution

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Abstract. Scientific literacy skill is one of the 21st century important skills needed to be developed in science learning. The purpose of this study is to inform students ability in scientific competence aspect of scientific literacy through Process Oriented Guided Inquiry Learning (POGIL) model with Socioscientific Issues (SSI) context on environmental pollution topic. The population in this research was all grade VII students of one of junior high school in Bandung and 53 students as research sample. The research used quasi-experimental design with 24 multiple choice questions items as research instrument. The experimental class was teached through POGIL with SSI context, while the control class was teached through scientific approach. Result obtained from t-test on normal and homogenous data shows that there are significant difference. N-gain of the indicators: explaining phenomena scientifically in the experiment class is 0.46 while in the control class is 0.17, evaluate and design scientific enquiry in the experiment class is 0.5 while in the control class is 0.25, interpret data and evidence scientifically in the experiment class is 0.75 while in control class is 0.71. Sientific literacy between students who received POGIL with SSI context is better than students who received scientific approach.

INTRODUCTION

Globalization era in the 21st century is marked by the rapid development of the world, including the development of science and technology. In education field, students need a lot of skills and abilities to be able to compensate the effect of globalization in the 21st century. One of the skills needed is science literacy skills which are one of the capabilities needed among the 16 identified skills [1]. Yore [2] suggested that in the First Island Conference one of the main issues that must be developed is the view of scientific literacy that need to be supported and must be informed to the public. Considering the importance of scientific literacy, educating people to have scientific literacy skills is the main goal in any science education [3], learning about scientific literacy is one of the important topics in science education [4], and scientific literacy is an educational goal recognized on an international scale [5]. Scientific literacy include several aspects such as the content domain, competence domain, context domain and attitude domain [6]. All domains are important for students to have in learning science. The focus of the study is on scientific competence which have three indicators, namely explaining phenomena scientifically, evaluating and designing scientific processes (inquiry), and interpreting data and evidence scientifically.

Science learning is one of the science education found in the Indonesian curriculum. Integrated science learning to develops scientific literacy must be well designed so that learning objectives can be achieved. Hand, Lawrence, & Yore, [7] assert that teacher use appropriate learning strategies before teaching scientific literacy. One of the strategy is to apply the student-centered learning (Student-Center), Isjoni & LN ([8] states that conversion based Teacher-Centered Learning (TCL) toward Student-Center Learning (SCL) is one of the efforts to answer the challenges of globalization that requires community graduates who are professionally competent. Researchers have developed many SCL-based learning models and one of the active student-centered learning is Process-Oriented Guided Inquiry Learning (POGIL). Some typical characteristics of POGIL are that the teacher acts as a facilitator and there are differences in the role of students when working in teams, namely: manager, reflector / technician, scriber, and presenter. Each role will be the same in one learning period but will change at each meeting [9]. POGIL has seven learning stages called the Learning Research Process, namely: Identification of the need for learning, Linking previous knowledge, Exploration, Understanding and concept formation, Practice applying knowledge, Applying Knowledge to new concepts, Reflection in processes [10].

Science learning that is used to build and optimize scientific literacy will be more meaningful if the teaching is associated with a context that is closely related to scientific literacy, one of which is Socioscientific Issues (SSI). Learning by applying SSI is learning that links learning to the context of students' daily lives, this makes it easier for students to discuss science in relation to the real world [11], so it can build student's scientific literacy skills and promote the nature of science [5]. Hodson & Wong [12] states that people who are literate in science are people who have knowledge, skills, attitudes, views, and values, all of which are needed by students and can be obtained when students associate learning with Socioscientific Issues.

The topic chosen from the content of integrated science is environmental pollution. The reason for choosing this topic is because it is considered more contextual and the phenomena are easier to find by students in their daily lives. Another reason is that environmental pollution is one of the topics discussed by PISA so students will have a deeper knowledge about environmental pollution through science literacy in SSI context.Students' awareness of how important it is to protect the environment, including the water environment, the air environment and the soil environment are very important to be built in students as a prepentive step in dealing with environmental pollution issues or phenomena that occur.

Learning about environmental pollution topic to students using the POGIL model with Socioscientific Issues context has the potential to be able to improve scientific literacy of students in aspects of scientific competence better than using conventional learning. The purpose of this study was to observe the effect of the POGIL model with Socioscientific Issues context on the topic of environmental pollution towards the improvement of scientific literacy of Class VII junior high school students on the competence domain. Based on the explanation above, the purpose of this study is to inform students ability in scientific competence aspect of scientific literacy through Process Oriented Guided Inquiry Learning (POGIL) model with Socioscientific Issues (SSI) context on environmental pollution topic. In addition, the POGIL model can be used as an alternative for teachers in conducting integrated science learning in the classroom so that it is more varied, especially to improve students' scientific literacy in aspects of scientific competence, and can be taken into consideration for other researchers in compiling POGIL learning with *SSI* context in developing student's science literacy skills.

EXPERIMENTAL DETAILS

The study used quasi experiment design with nonequivalent pretest-posttest control group design. The population in this study was all grade VII students of one of junior high school in Bandung regency that spread in ten classes and 53 students as the sample that chosen bycluster random sampling as sample selection technique. Subjects of the study were 26 students of class VII-H for experimental class and 27 students of class VII-F for control class.

The instrument used in this study is multiple choice with 24 questions items that were used to obtain students' scientific literacy data on aspects of scientific competence which have three indicators namely explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically. The data were analyzed by using normality test (Kolmogorov-Smirnov test), homogeneity test (Levene test) and test of hypothesis by using t-test test with software of IBM SPSS 24.00.

RESULTS AND DISCUSSION

Scientific literacy analysis of students in the scientific aspects of competence is carried out on three indicators of scientific competence into three indicators: Interpret data and evidence scientifically, explain phenomena scientifically, and evaluate and design scientific enquiry. The results of the pretest and posttest of the two classes then carried out prerequisite tests, namely normality and homogeneity before testing the hypothesis. The pretest normality test was carried out with using of IBM SPSS 24 software, namely the Kolmogorov-Smirnov test with a confidence level of 95% or a significance value of 0.05, the homogeneity test was carried out with the Levene test. If the data normal and homogeneous, then continue with hypothesis testing using the t-test. The results of the normality and homogeneity, and hypothesis of pretest of the two classes shown in Table 1 below.

TABLE 1. Results of Normality, Homogeneity, and Hypothesis Test of pretest

Data	Class	Normality (Kolmogorov-Smirnov[a])		Homogeneity (Levene Test)		Hypothesis Test (t-test)	
		Sig.	Conclusion	Sig.	Conclusion	Sig.	Conclusion
Pretest	Experiments	0.20	Normal	0.62	Homogeneous	0.72	No significant differences
	Control	0.23	Normal				

Based on Table 1, the results of the normality test indicate that the value of sig pretest is > α (0.05) so that it can be concluded that the data is normally distributed and the results of homogeneity tests of scientific competence aspect show that sig pretest is > α (0.05) so it can be concluded that the pretest data of both classes are homogeneous, which means the research subjects in the experimental class and the control class have the same ability or homogeneous variance. The next stage after obtaining data that is normally distributed and has a homogeneous variance, then the parametric statistical test is performed using the t-test. Purpose of the t-test is to find out whether there are differences or there are no differences in the results of the pretest data between the experiment class and the control class. Based on Table 1 the results of the pretest t-test on the aspects of scientific competence that have been carried out indicate that the initial abilities of the two classes have no significant differences, as evidenced by p-value or Sig is > α (0.05). This means, before both classes received treatment, the ability of the two classes is not a significant difference. Furthermore, hypothesis testing was performed on the posttest results of students' scientific literacy skills in aspects of scientific competence. The posttest test aims to see whether the final results of students after applying different or not different treatments. For the results of normality and homogeneity test and posttest t-test both classes can be seen in Table 2 below.

TABLE 2. Results of Normality, Homogeneity, and Hypothesis Test of Posttest

Data	Class	Normality (Kolmogorov-Smirnov[a])		Homogeneity (Levene Test)		Hypothesis Test (t-test)	
		Sig.	Conclusion	Sig.	Conclusion	Sig.	Conclusion
Posttest	Experiments	0.20	Normal	0.11	Homogeneous	0.018	Significant differences
	Control	0.20	Normal				

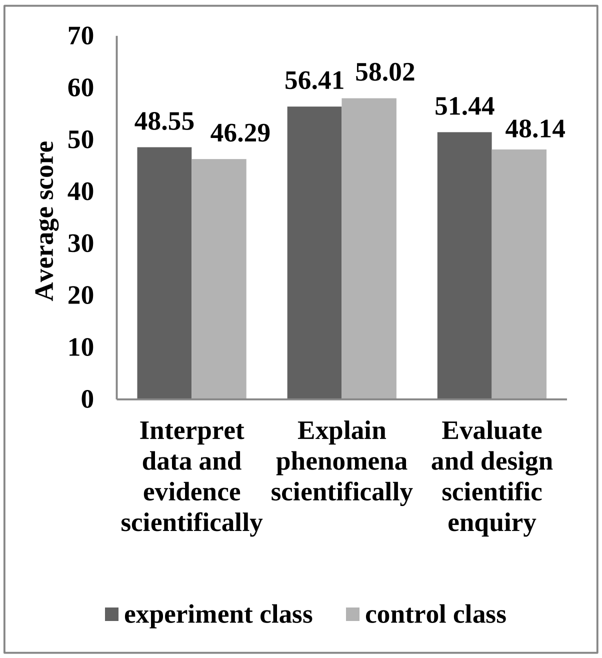
Based on Table 2, the results of the normality test indicate that the value of sig posttest is > α (0.05) so that it can be concluded that the data is normally distributed and the results of homogeneity tests of scientific competence aspect show that sig posttest is > α (0.05) so it can be concluded that the posttest data of both classes are homogeneous, which means the research subjects in the experimental class and the control class have the same ability or homogeneous variance. The next stage after obtaining data that is normally distributed and has a homogeneous variance, then the parametric statistical test is performed using the t-test.. Based on Table 2 the results of the posttest t-test on the aspects of scientific competence that have been carried out indicate that the initial abilities of the two classes have significant differences, as evidenced by p-value or Sig is < α (0.05). This means, after both classes received treatment, the ability of the two classes is have a significant difference.

The recapitulation of the average scores for the pretest, posttest and N-gain of students in scientific competence aspect of the experimental class and control class is presented in Table.3.

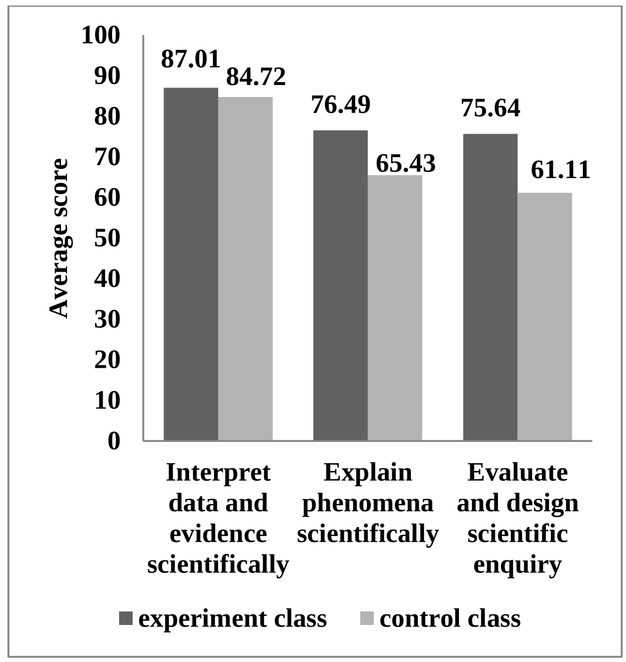
TABLE 3. Recapitulation of the average score for pretest, posttest and N-gain the scientific competence

Indicators of Scientific competence	Pretest		Posttest		N-gain	
	experimental	Control	Experiment	control	Experiment	Control
Interpret data and evidence scientifically	48.55	46.29	87.01	84.72	0.75	0.71
Explain phenomena scientifically	56.41	58.02	76.49	65.43	0.46	0.17
Evaluate and design scientific enquiry	51.44	48.14	75.64	61.11	0.5	0.25

The following is a graphical picture of the average score of pretest and posttest of the experimental class and the control class in scientific competence aspect.



(a)



(b)

FIGURE 1. The graphs of the pretest average (a) and the posttest average (b) of the experimental class and the control class of scientific competence

Based on the Tabel 3 and Figure 1, the results of the average percentage of pretest of scientific competence between experiment class and control class showed that the pretest values of the two classes were not much different in each indicator of scientific competence, this shows that before use POGIL model with SSI context in experiment class and scientific approach in control class, the initial ability of the two classes is not significant different. The average posttest in the experimental class using the POGIL model in the SSI context increased from the average pretest and was higher than the increase in the control class that using the learning commonly used in school, namely the scientific approach. This is appropriate with the research conducted by Hale & Mullen [13] who applied POGIL learning to chemistry topic, compared to learning commonly used in school, with five quis being conducted, learning outcomes and average quis increased higher in the class applied by the POGIL model.

After giving different learning treatments to the two classes, the results of the average posttest percentage of each scientific competence indicators in the experimental class had a higher score than the control class score. The indicator explaining the phenomenon scientifically has a posttest score of 76.49 while in the control class has 65.43, the indicator evaluating and design scientific enquiry has a posttest average of 75.64 while the control class is 61.11. For these two indicators the two classes have significantly different values. The indicator of interpreting data and evidence scientifically has a posttest mean value of 87.01 while in the control class 84.72. Beside the results of the average posttest percentage of each scientific competence indicators, the experimental class has a higher score than the control class score. This shows that the final grades of the two classes significantly different. This is evidenced by the average n-gain of the two classes in all indicators of scientific competence aspect. The N-gain experimental class has a higher gain compared to the n-gain control class.

Based on the research that has been done, there are nine questions that measure indicator of explaining phenomena scientifically of scientific competence. Based on the data, it can be seen that the n-gain of the indicator explaining phenomena scientifically in the experimental class which is equal to 0.46 and include into the medium category, while in the control class only 0.17 and include into the low category. In the experimental class applied in the POGIL learning model in the context of SSI, a sufficiently high increase in indicator explaining phenomena scientifically of course from the role of learning in POGIL and SSI, which presented paper news and video news in the form of factual phenomena related to environmental pollution topic observed directly by students. It can be seen when students are able to explain the contents of the news, they discuss to analyze the contents of the article at the stages in POGIL learning. So that when students are given questions that demand to explain scientific phenomena, students are able to answer the question.

The indicator of evaluate and design scientific enquiry have seven questions that require students to be able to analyze and evaluate the results of practicums and investigations that have been carried out, and are able to design scientific enquiry related to environmental pollution topic. Based on the data, this increase or n-gain indicator in the experimental class is 0.5 and is include the medium category while in the control class is 0.25 and is include the low category. Fairly large increase in the experimental class applied by the POGIL model in the SSI context can be analyzed from learning activities because students are trained to do practicum or investigation independently without much guidance from the teacher, and when activities analyze SSI contextual articles news, which aim to link learning topic to context students' daily lives, especially about environmental pollution topic, and students are trained to design processes to prevent the impact of environmental pollution and design to reduce environmental pollution. Whereas in the control class that used scientific approach there is no activity. The SSI context used in the experimental class has a major influence in training students' scientific literacy, and this is consistent with the opinion of Calik & Coll [14] that SSI based articles news that contain issues and phenomena related to scientific literacy make students enthusiastic in learning, which meaning that SSI can help introduce science literacy to students.

The indicator of interpret data and evidence scientifically from the aspect of scientific competence, there are eight questions that require students so that students can analyze and evaluate research data, express opinions or arguments with various perspectives and draw conclusions scientifically. Based on the data, the increase or n-gain of this indicator in the experimental class is 0.75 and is included in the high category while in the control class is 0.71 and also included the high category. High increase in the experimental class applied by the POGIL model in the SSI context can be analyzed from exploration learning activities and investigations conducted by students. Students are enthusiastic in carrying out practical activities which they have so rarely been able to get, and the results of the practicum obtained by students right and in accordance with the results of the practice. This is supported by the characteristics of POGIL learning which requires the division of roles (manager, reflector / technician, scriber, and presenter) in groups when discussion, therefore make discussions become effective. This certainly supports the effectiveness of learning.

Based on the data above, the increase in students' scientific literacy in the aspect of science competency as a whole indicator was higher in the experimental class using POGIL and SSI context compared to the control class using the scientific approach.

CONCLUSION

Based on the data analysis and discussion, it can be concluded that the increase in students' scientific literacy in aspects of scientific competence is higher in the experimental class that received POGIL model with SSI context compared to students who received scientific approach in the control class. The characteristics of POGIL learning which requires the division of roles (manager, reflector / technician, scriber, and presenter) in groups when discussion make discussion become effective. Socioscientific Issues (SSI) context is very appropriate to be applied to students because the context and phenomena of SSI are close to the lives of students and make students interested in learning that they have never had before.

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