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The Effect of Guided Inquiry-Based Practicum Learning and Prior Knowledge on Learning Outcomes and Science Process Skills of High School Students on Solubility and Solubility Products

Jakub Sadam Akbar*, I Wayan Dasna, Surjani Wonorahardjo
Chemistry Education-Universitas Negeri Malang
Jl. Semarang 5 Malang 65145, Jawa Timur, Indonesia. E-mail: saddamakbar791@gmail.com*

Abstract: This study aimed to compare the students' learning outcome and science process skill that learned by two different methods viewed from prior knowledge. This study used the quasi-experimental design. The research's instruments were student's learning outcome and science process skill test. Data were analyzed using by MANOVA. The results showed that: (1) there was differences in student's learning outcome and science process skill that learned with guided inquiry based laboratory activities and verification based laboratory; (2) there was no interaction between learning methods in laboratory activity and prior knowledge on student's learning outcome. Thus, the guided inquiry strategy has enhanced student's learning outcome and science process skill.

Key Words: guided inquiry, laboratory activity, prior knowledge

Abstrak: Penelitian ini bertujuan untuk mengetahui perbedaan hasil belajar dan keterampilan proses sains siswa yang dibelajarkan dengan dua metode berbeda ditinjau dari pengetahuan awal. Penelitian ini menggunakan rancangan penelitian eksperimen semu. Instrumen pengukuran yang digunakan dalam penelitian ini adalah tes keterampilan proses sains dan hasil belajar siswa. Data dianalisis menggunakan MANOVA. Hasil penelitian menunjukkan bahwa: (1) ada perbedaan hasil belajar dan keterampilan proses sains siswa yang dibelajarkan dengan praktikum inkuiri terbimbing dan praktikum verifikasi, (2) tidak terdapat interaksi antara strategi pembelajaran dalam kegiatan praktikum dan pengetahuan awal terhadap hasil belajar siswa. Simpulannya adalah praktikum inkuiri terbimbing dapat meningkatkan hasil belajar dan keterampilan proses sains siswa.

Kata kunci: inkuiri terbimbing, kegiatan praktikum, pengetahuan awal

INTRODUCTION

Chemistry is part of the natural science branch that deals with changes in substances, sub stance structure, properties of substances, principles, laws that explain changes in substances, as well as theories and concepts that describe the process of changing substances (Effendy, 2016). According to Kean and Middlecamp (1985) the concepts contained in chemistry have certain characteristics that are interconnected and gradual from the basic concepts to higher concepts and are complex, further disclosed that chemical concepts are largely abstract. Abstract and complex nature contained in the concept of chemistry, makes it difficult for students to understand the material (Sirhan, 2007).

The solubility material and the solubility product are part of the discussion of chemical concepts that students learn in class XI. The material requires an algorithmic understanding ability and is abstract (Tacettin & Canpolat, 2003). The abstract nature shown by the microscopic representation of this material makes students find it difficult to master the material (Bonomo, 2011). This difficulty is explained by several studies, one of which is the results of Nisak research (2010) which found that 45.23% of students had difficulty mastering and determining solubility, 39.28% of students had difficulty mastering and de-

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termining the results of solubility times, 75.50% of students found it difficult to master and determine the solubility of substances containing namesake ions, and 38.77% of students had difficulty determining the depositional reaction. Similar research was also conducted by Magfirah (2011) who found that 37.9% of students had difficulty understanding the concept of solubility results, 50.1% of students had difficulty understanding solubility, 47.0% of students had difficulty understanding the influence of namesake ions and pH, and 66.3% of students have difficulty predicting depositional reactions. Difficulties experienced by students to master the understanding of the concept of the material, resulting in students experiencing misconceptions (Tacettin & Canpolat, 2003).

Based on the problems encountered in studying the material, the teacher generally tries to answer the problems obtained by students through the application of practicum to help students explore the concept of solubility and solubility results better. The use of practicum carried out in general is still verification, this is supported by the statement of Domin (2007) which revealed that the most dominant type of laboratory activity at present is the verification laboratory activity known as the "cook book" this statement is supported by the findings of Riskiana et al., (2015) in a study of practicum implementation in high school which shows that verification practicum activity is the most dominant type of practicum used in high school.

The use of similar practicum activities was also found in the schools that became the study sample. Based on interviews conducted with teachers and laboratory assistants, it is known that the type of practicum conducted is verification, and it is also known that not all chemical materials that can be explained by practicum are taught with practicum. According to Ural (2016) verification practicum is practicum done by directing students to follow written instructions step by step and students only think about following the directions written in the laboratory manual. The use of practicum activities will have an impact on the passivity of students to be actively involved in the learning process (Schroeder et al., 2008).

Finally, the habits of students who only do practicum activities based on practicum worksheets indicate that students do not develop their thinking skills to construct a concept. This problem then causes students to have difficulty in building understanding of understanding concepts. One indicator that shows the difficulty of students in understanding a concept is the low student test scores on the concept of solubility and solubility results. Data on daily recapitulation of students on the solubility material and the solubility results in the school which is a research sample shows that most students are still below the minimum completeness criteria of 75 with the percentage of students graduating 33.34%.

METHOD

The research design carried out was quasi-experimental. The study was conducted in May 2017 with a total of five meetings. The population in this study included all students of class XI IPA SMAN 5 Kupang in the Academic Year 2017/2018. The sampling technique uses cluster random sampling techniques. Based on this technique, two samples were obtained, namely class XI IPA 3 as a control class treated through verification practicum and class XI IPA 1 as an experimental class taught through guided inquiry practicums. This study uses two types of instruments, namely measurement instruments and treatment instruments. The treatment instruments included LKS and RPP, while the measurement instruments used were tests. The instruments are tested for validity and reliability before they are implemented to students,

There are two types of validity in this study, namely the validity of items and content. The results of the content validity test of the instruments in this study have a very high category, while in the test of the validity of the learning outcomes there are 18 valid questions and two invalid items, while in the science process skill questions an invalid question is obtained. Based on the reliability test, it is known that the test of learning outcomes and the process skills used are reliable. Data obtained through this learning process are initial knowledge, science process skills and student learning outcomes that are analyzed quantitatively using MANOVA. Students initial knowledge data were analyzed using the t test to find out the equivalence of students' initial knowledge in both class samples. The analysis prerequisite test will be carried out before analyzing the data using t test. The following results of the average similarity test, homogeneity test, and normality are listed in Table 1 and Table 2.

RESULTS

Initial Knowledge Description

Student's initial knowledge data is obtained based on the average daily test scores on the previous material. The initial knowledge data is used to see the

Table 1. Normality and Homogeneity Tests of Students' Initial Knowledge

Class	Normality test	Homogeneity test
	Kolmogorov-Smirnov ***(Asymp. Sig (2-tailed)***	***Levene's Test***
Guided Inquiry	0,417	0.272
Verification Practicuum	0,214	

Table 2. Average Similarity Test of Students' Initial Knowledge

Compared class	df	A	F	Sign. (*2-tailed*)	Criteria
Guided inquiry and verification	70	0,05	1.227	0,102	α < sign. (2-tailed)

equality of the sample used, and to differentiate students according to the level of initial knowledge students have. A summary of students' initial knowledge data in the two sample classes is given in Table 3.

Students' Learning Outcomes

Student learning outcomes data is obtained based on tests given to students after receiving treatment. The acquisition of student learning outcomes data in both class samples is presented in Table 4.

Table 4. Students' Learning Outcomes

Class	Total	Avg Score	Category	Avg
Guided Inquiry	36	79,16	High	82,74
			Low	75,15
Verification	36	72,06	High	74,07
			Low	70,63

Description of Student Process Skills

Data on students' process skills is obtained through science process skills tests which are distributed to students after receiving treatment. A summary of students' process skills data is presented in Table 5.

Table 5. Students' Processing Skill

Class	Total	Avg Score	Avg
Guided	36	80,63	82.26
Inquiry			78.28
Verification	36	73,53	73.95
			73.06

Tables 3 and 5 show that there are differences in science process skills and learning outcomes learned through guided inquiry and verification activities. Based on Tables 4 and 5, it is known that students who are taught through guided inquiry practice have better scientific process skills and learning outcomes than students in verification practice classes, while from Table 4 it is also known that students with high initial knowledge have student learning outcomes that are better than students with low initial knowledge. However, to find out whether there is a significant difference or not in the data on learning outcomes and science process skills both based on variations in practicum activities or initial knowledge, the MANOVA test is performed. The MANOVA test results are given in Table 6.

The results of the first hypothesis test shows that the acquisition of significance value is (0.003) < 0.05,

Table 3. Students' Initial Knowledge

Class	N	Avg	Min Score	Max score	SD	Category	Total
Guided Inquiry	36	74.44	48	88	9,73	High	19
						Low	17
Verification	36	72.02	50	86	10,14	High	18
						Low	18

Table 6. MANOVA Results

Source	Dependent Variable	df	F	Sig.
Class	Learning outcomes	1	9,164	0,003
	Science processing skills	1	15,159	0,000
Initial_ Knowledge	Learning outcomes	1	8,739	0,004
	Science processing skills	1	2,209	0,142
Class* Initial_ Knowledge	Learning outcomes	1	0,143	0,706
	Science processing skills	1	1,004	0,320

so H1 is accepted. This means that there are significant differences in learning outcomes in students who are taught by applying different variations of practical activities. The results of the second hypothesis test indicate that the acquisition of significance value is (0,000) < 0.05, so H1 is accepted. It shows that there are differences in science process skills between students who are taught through guided inquiry practice and verification practice. The results of the third hypothesis test on the writing "Class* Early_Knowledge" shows that the interaction of initial knowledge with practicum activities (guided inquiry and verification) on student learning outcomes has a significant value acquisition (0.706) > 0.05, so H0 is accepted. This shows that there is no interaction between students' initial knowledge and practicum activities (guided inquiry and verification) on student learning outcomes.

DISCUSSION

The Effect of Practicum Activities (Guided Inquiry and Verification) on Student Learning Outcomes

Based on the results of the research in Table 4, it is known that the average student learning outcomes that are taught with guided practicums are higher than students in the verification practicum class. MANOVA test results in Table 6 show there are differences in learning outcomes between students who are taught through guided inquiry practicums and verification practicums. The high student learning outcomes in classes that implement guided inquiry practicum activities can be caused by the stages of guided inquiry-based practicum activities that are able to invite students to actively engage in searching, building and finding understanding of concepts learned so that students do not merely accept concepts. The same thing was also expressed by the results of Yakar and Baykara's (2014) research that the effectiveness of inquiry-based laboratories occurred because this strategy could arouse students' curiosity by directing students to discuss the problems given and directing students to look for, and facilitating students to actively participate in the process. In addition, the steps in guided inquiry practicum activities can assist students in experiencing a series of scientific processes themselves like scientists do in discovering new knowledge so as to make student learning more meaningful.

Effect of Practicum Activities (Guided Inquiry and Verification) on Science Process Skills

The high science process skills in the guided inquiry practicum class can be caused by the stages of the guided inquiry practicum which includes giving problems, formulating hypotheses, experiments, evaluating hypotheses and making conclusions that can facilitate students in conducting and practicing science process skills in the form of observation, problem formulation, making hypothesis, design of the experiment, and communicating the results to find conclusions solving the problem. When students do activities using guided inquiry practice, students are actually trained to improve the science process skills themselves. This is supported by the statement of Trianto (2010) that process skills will develop in processes that are repeated. Students will not be skilled if they do not have the opportunity to carry out the process itself continuously. The same thing was expressed by Wenning (2006) that the skills possessed by students will develop if students have experience in doing and practicing these skills. The results of this research are in accordance with research results obtained by Ceylan and Vekli (2016) and Blanchard et al., (2010) who found that inquiry learning with a laboratory can develop students' science process skills.

Interaction between Practicum Activities Based on Learning Strategies and Initial Knowledge of Student Learning Outcomes

Based on the results of the analysis of the effect of interactions or a combination of practicum activities (guided inquiry and verification) and initial knowledge of learning outcomes obtained through the MANOVA test in Table 5 shows that there is no interaction effect on students taught with guided inquiry practicum activities and verification practicum activities with pay attention to student's initial knowledge, namely low initial knowledge and high initial knowledge of student learning outcomes. So it can be concluded both the independent variable and the moderator variable when viewed separately they both have their own influence on learning outcomes. The results of this study are in line with Howel's statement (2011) which states that if there are two independent variables that have a parallel effect on the dependent vari-able, then the interaction that occurs in the two independent variables does not occur.

CONCLUSIONS

After conducting this experiment some conclusions were obtained. The first is that there are differences in learning outcomes between students who are taught with the verification practice and the guided inquiry practice. Students who are taught using verification practices have lower learning outcomes than students who are taught using guided inquiry practices. The second conclusion is that there are differences in science process skills between students who are taught with guided inquiry practice and verification practice. Students who are taught using verification practices have lower scientific process skills than students who are taught using guided inquiry practice. As for the two conclusions it can be understood that apparently there is no interaction / influence of practicum activities (verification and guided inquiry) and initial knowledge together on student learning outcomes.

Some suggestions can be given after this research. Chemistry learning in schools should pay attention to students' initial knowledge as variables that also influence learning outcomes, so that teachers can make informed learning strategy decisions to be taught to students. The same approach should also be used for some other similar chemical material, which also requires practicum to understand the concept.

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