

The Effect of Using Student Worksheets Based on Guided Inquiry on Acid Base Materials to Improve Learning Outcomes Student in SMAN 4 Padang

Aisyah Fitri Rusiani Js, Mawardi Mawardi, Fitra Handayani

Chemistry Department, Faculty of Mathematics and Natural Science

Universitas Negeri Padang

Jln. Prof. Dr. Hamka Air Tawar, Padang, 25131, Indonesia



Abstract - This study aims to determine the effect of guided inquiry-based student worksheets on acid-base material to improve student learning outcomes. The quasi experiments were conducted using *Non-equivalent Control Group design*. The population in this study was all students of class XI IPA SMAN 4 Padang 2018/2019. *The purposive cluster sampling was used as the sampling technique. The sample of this research is XI IPA 5 as experimental class (n = 32 students) and XI IPA 6 as control class (n = 32 students).* The experimental group is taught to learn using guided inquiry-based student worksheets, while the control group is taught by not guided inquiry-based student worksheets. The research instrument used was the learning outcome test, in the form of 25 objective option questions. The results showed that guided inquiry-based student worksheets had an effect on student learning outcomes, as evidenced by an increase in the average score from pretest to posttest. The results of the normality and homogeneity test state that the learning outcomes of the two samples are normally distributed and homogeneous. The results of the t-test were obtained by sig. (2-tailed) of $0.002 < 0.05$ means that the learning outcomes of students who learn using guided inquiry-based student worksheets and without guided inquiry-based student worksheets differ significantly.

Keywords - Effectiveness, Student Worksheets Based On Guided Inquiry, Learning Outcomes.

I. INTRODUCTION

Education is a process of developing self-potential that is carried out consciously and programmed to develop themselves in order to face all existing problems. Education is also one of the factors that determine the progress of a nation, it is hoped that education can create a generation of people who are responsive to change (Fikka, 2017: 1). Therefore, there needs to be an increase in human resources that can develop their potential from various fields of science (Hamalik, 2015: 54).

Education covers various fields of science, one of which is natural science (IPA) and one part of natural science is chemistry. Chemistry is the study of the composition and properties of matter and the occurrence of a chemical reaction

(Brady, 2009: 23). Chemistry is classified as a difficult and abstract subject so that many students are afraid to learn it (Zammiluni, 2018: 60). According to Sunyono, et al (2009: 2), in the learning process students are given less direct experience in observing a chemical reaction. In addition, students have difficulty in solving problems related to chemical reactions and calculations. This is caused by a lack of understanding of chemical concepts and interest of students in chemistry lessons so that students consider chemistry subject matter to be abstract and difficult to understand.

Jansoon, et al (2009: 149) also states that chemistry consists of many abstract concepts and topics. Abstract

concepts of chemistry can be explained using submicroscopic levels in multiple levels of representation. Multiple representations consist of three levels, namely macroscopic, submicroscopic and symbolic levels (Chittleborough, 2007: 274). In general, chemical learning that occurs now only limits the two levels of representation, macroscopic and symbolic. Learning at the submicroscopic level is only presented through lectures and discussions, so that students consider chemistry learning material to be abstract and difficult to understand or learn (Elma, 206: 2). Gilbert (2009: 3) suggests that learning using multiple representations will be more maximal if the three levels are well interconnected.

Chemistry is a science that is acquired and developed based on investigation through experiments or experiments. So chemistry is very closely related to learning inquiry. As revealed by Hartono (2013: 72), the type of inquiry that is usually used in high school students is guided inquiry. So that in the process of implementing inquiry learning still requires a lot of guidance from the teacher so that all stages of inquiry can be achieved to the fullest. Guided inquiry consists of 5 stages, namely exploration orientation, concept formation, application and closure (Hanson, 2005: 1). This step can be applied to media or teaching materials such as well-designed student worksheets, this is done so that the material delivered through intermediary teaching materials can arouse students' curiosity and optimize students' abilities. Student Worksheets are teaching materials that contain tasks that must be done by students. When students answer questions on student worksheets, their cognitive activities and understanding will improve (Gait, 2018: 679).

Some of the results of related research such as Aini (2017) that implement guided inquiry learning models into the worksheet of students in chemical equilibrium material. Irham (2016) applies student worksheet to hydrolysis material. In general, student worksheets based on guided inquiry can improve students' understanding and ability to learn effectively.

II. LITERATURE REVIEW

Student worksheets are printed teaching materials in the form of sheets of paper that contain a series of tasks with questions that make it easier for students to carry out investigative or problem solving activities that can be combined with certain learning models. In this study the student worksheets used were guided inquiry-based worksheets.

This guided inquiry-based student worksheet is a worksheet in which there are activities that are in accordance with the guided inquiry learning cycle. The activity in question is in-class activities and activities in the laboratory. Explanation of the five stages of guided inquiry, namely first, orientation is the stage of

connecting old knowledge with new knowledge. The exploration phase is the stage for students to analyze data and collect data. At this stage students are given a model in the form of images, graphics, data tables and others. The concept formation stage is the stage where the teacher leads a brief discussion to introduce the concept and interpret the data. Each concept is explored with one or more models and guided by *critical thinking questions*. Key questions are at the heart of guided inquiry activities (Hanson, 2005: 2-3).

When students explore the model and answer the key questions given means students have entered the stage of formation concept. After the concept is identified and understood, strengthened and expanded in the application stage. At the application stage is the stage of giving practice and questions. In the closing stages students draw conclusions, reflect on what they get, and assess their performance. In addition, this student worksheet is designed involving three levels of chemical representation, namely macroscopic, submicroscopic, and symbolic which are arranged based on the stages of guided inquiry learning. Johnstone in Jansoon (2009: 149) suggests that in order to understand the chemistry, one must understand knowledge at three levels of representation, namely macroscopic, sub-microscopic, and symbolic levels.

III. METHODOLOGY

Type of research used is quasi-experimental research. In this type of research the control group cannot function fully to control external variables that affect the implementation of the experiment (Sugiyono, 2013: 116).

The research design used is *Non-equivalent Control Group Design*. *Non-equivalent Control Group Design* is a research design similar to the *Pretest-posttest Control Group Design* only in this design group experiments and control groups were not randomly selected. In this study there were two classes each without randomly selected, namely the experimental class and the control class and for each group held *pretest* and *posttest* were. *Pretest* to find out the initial condition, is there a difference between the experimental group and the control group. The results of *pretest* a good are if the value of the experimental group and the value of the control group are not significantly different (Sugiyono, 2011: 113). The experimental class in learning uses a guided inquiry learner worksheet, while the control class uses teaching materials used in school. The guided inquiry-based ape

sheet on acid-base material used in this study is a worksheet developed by Sister Widya Astuti (2017) and has been declared valid and practical. However, its effectiveness has not been tested.

In detail *Non-equivalent Control Group Design* can be seen in Table 1 below:

Table 1. *Non-equivalent Control Group Design*

Class	Pretest	Treatment	Posttest
E	O ₁	X	O ₂
K	O ₃	-	O ₄

Description:

E = Class Experiment

K = Class Control

O₁ = Value *pretest* experimental class before being treated

O₂ = Value *posttest* experimental class after being treated

X = The treatment given to the experimental class is learning using student worksheets on acid base material based on guided inquiry

O₃ = The value of *pretest* the control class

- = The treatment given to the control class is learning using teaching materials available in schools

O₄ = Value of *posttest* of control class

The population of this study was students of class XI IPA of SMA Negeri 4 Padang in the academic year 2018/2019. Sampling in this study used *Cluster Purposive Sampling* technique that is technique by selecting classes (not individuals) with certain considerations, obtained the sample class in this study was XI IPA 5 as the experimental class and XI IPA 6 as the control class. The instruments used were the multiple choice acid base test questions totaling 25 questions.

IV. RESULTS AND DISCUSSION

Data analysis of learning outcomes was conducted sequentially, starting from looking at the differences in the values of the experimental class and the control class, the normality test, the homogeneity test, and the t-test. From the two sample classes obtained learning outcomes data in Figure 1.

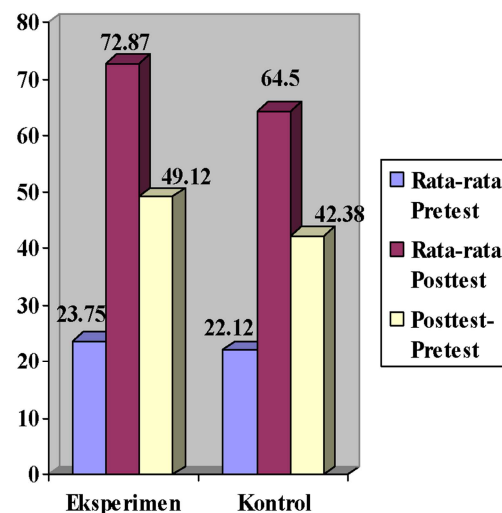


Figure 1. Graph of Sample Class Learning Results

From the picture above it is known that the average value of the initial test (*pretest*) of student learning outcomes between the experimental class and control class has a value that is not much different. This means that students from both sample classes have similar initial abilities. The final test score (*posttest*) of student learning outcomes after being treated with learning was obtained by the average *posttest* of the experimental class higher than the control class. It can be seen that the difference in the value of the experimental class is higher than the control class, the difference in the value of the *posttest* and *pretest* is useful in testing the normality, homogeneity and hypothesis testing.

The normality test used is *Kolmogorov-Smirnov*. The results of the normality test can be seen in Table 2.

Table 2. Normality Test Results

Class	α	Sig.	Distribution
E	0.05	0.821	Normal
K		0.329	Normal

Based on the table above the sample data has a significance value > 0.05 at the real level $\alpha = 0.05$. Thus, the value of the *posttest-pretest* learning outcomes of the two samples was normally distributed.

The homogeneity test used is the test *Levene*. The homogeneity test results can be seen in Table 3.

Table 3. Homogeneity Test Results

Class	α	Sig.	Distribution
E	0.05	0,057	Homogeneous
K			

Based on the table above, sample data has a significance value > 0.05 at a significant level $\alpha = 0.05$. Thus, the value of the *posttest-pretest* learning outcomes of the two samples has a homogeneous variance.

Hypothesis testing is carried out after conducting a normality test and homogeneity test on research data derived from the value of the difference *posttest-pretest*. From the results obtained indicate that the sample class is normally distributed and has a homogeneous variance. Therefore, to test the hypothesis used the *independent sample t-test*. Acceptance criteria if the value is *sig. (2-tailed)* > 0.05 then H_0 is accepted and if the value is *sig. (2-tailed)* < 0.05 so H_0 is rejected. Hypothesis test results on learning outcomes can be seen in Table 4.

Table 4. Hypothesis Test Results Learning Results Sample

Class	<i>Sig. (2-tailed)</i>	Decision
E	0.002	H_0 rejected
K		

Based on the table above the sample class has a *Sig. (2-tailed)* less than 0.05 which is 0.002, so it can be concluded that H_0 is rejected. H_0 rejecting decision means learning outcomes of students who learn using guided inquiry-based student worksheets and without guided inquiry-based student worksheets differ significantly. This means that there is the influence of using guided inquiry-based student worksheets on acid-base material on student learning outcomes.

This is in line with the results of Blanchard's study (2010: 578) found that students who received guided inquiry-based learning had higher scores in various types of knowledge (conceptual, procedural, and question test scores) and better long-term general retention than students who study conventionally. The same results of the study were also stated by Dewi (2013: 9) saying that learning outcomes using guided inquiry-based learning were better than conventional learning.

With the use of guided workshops based on guided incursions conducted in group learning systems can make

students work together in building their understanding and knowledge, so that students are easier to remember and understand (Hanson, 2006: 4). This can be seen when students answer key questions, students work together and discuss in answering key questions. Thus learning becomes more effective and will have a positive effect on scientific attitudes, students' thinking skills and student learning outcomes. This is in line with the opinion expressed by Hanson (2005: 1) which suggests that learning becomes more effective, students work together with each other by much discussion both in groups and between groups.

This inquiry-based student worksheet is also equipped with multiple representations, namely macroscopic, submicroscopic and symbolic. The three levels are interconnected with each other well. At the macroscopic level in the form of a solution image, the submicroscopic is in the form of ions of components of acidic and basic solutions. While at the symbolic level in the form of a reaction that occurs. So that students better understand the concept of chemistry both concretely and abstractly. In textbooks used in schools not equipped with submicroscopic levels, there are only macroscopic and symbolic levels. So that it is not well interconnected. This agrees with what was stated by Gilbert (2009: 3) which suggests that learning using multiple representations will be more maximal if the three levels are well interconnected, because they can represent chemical phenomena and explain the phenomena qualitatively and quantitatively.

V. CONCLUSION

The effectiveness of students' worksheets is seen from the comparison of the learning outcomes of experimental class and control class students with a 95% confidence level of a significant level (α) of 0.05. Hypothesis testing shows that the learning outcomes of students with those who learn using guided inquiry-based student worksheets and without student worksheets are significantly different. This means that there is the influence of the use of student worksheets on acid-base material on student learning outcomes. where the learning outcomes of learners who learn using guided inquiry-based student worksheets are higher than without guided inquiry-based student worksheets.

ACKNOWLEDGMENTS

I am very pleased to Dr. Mawardi, M.Si., Widya Atuti, S.Pd., Fitra Handayani, S.Pd, both parents, colleagues at Padang State University, teacher and student at SMAN 4 Padang who has helped this study.

REFERENCES

- [1] Maypalita, Fika., Mawardi., Rahadian Zainul. 2017. Effect of Using Student Worksheets (Based on Guided Learning) Based on Guided Inquiry on Buffer Solution Material for Learning Outcomes of Class XI Students of SMAN 5 Padang Science. Padang State University, Padang.
- [2] Hamalik, Oemar. 2015. Curriculum and Learning. Jakarta: Bumi Aksara.
- [3] Brady, James E. 2012. *Chemistry: the Molecular Nature of Matter*. New York: John Wiley & Sons, Inc.
- [4] Zammiluni. 2018. Development of Guided Inquiry Based Work Sheet with Class and Laboratory Activity on Chemical Bonding Topic in Senior High School. *International Journal of Chemistry Education Research*-Vol. 2 Iss. August 2, 2018.
- [5] Sunyono. 2009. "Theoretical Study of Chemistry Learning Models Based on Multiple Representations (Si Mayang) in Building Mental Models of Students". Articles presented in *Proceedings of the National Science Seminar*, Surabaya State University, Surabaya, January 14.
- [6] Chittleborough, G. & Treagust, DF 2007. The Modeling Ability of Non-Major Chemistry Students and Their Understanding of the Sub-microscopic Level. *Chemistry Education Research and Practice*, 10 (4): 281-290.
- [7] Rahman, Elma Fadrita., Mawardi., Rahadian Zainul. 2017. Effect of Using Student Based Worksheets (LKS) Based on Salt Hydrolysis Material on Learning Outcomes of Class XI Students of SMAN 13 Padang. Padang State University, Padang.
- [8] Gilbert, J. K & Treagust, DF 2009. *Multiple Representation in Chemical Education*. Dordrecht: Springer.
- [9] Hartono, Rudi. 2013. *Variety of Teaching Models that are Easy to Accept by Students*. Yogyakarta: DIVA Press.
- [10] Gait, P., Umar Kalmar Nizar., Mawardi. 2018. Development of Student Worksheet Based On Guided Inquiry with Class Activity and Laboratory In Thermochemistry Materials. *International Conferences on Education, Social Sciences and Technology, Padang*.
- [11] Aini, FQ, Mawardi., And Oktavia, B. 2017. *Guided Inquiry Based Student Worksheet on Chemical Equilibrium Topic*. German: LAP Lambert Academic Publishing
- [12] Irham, SM, Mawardi and Oktavia, B. 2016. The Development of Guided Inquiry Based Worksheets on Colligative Properties Solution for Chemistry Learning ". *International Conference On Mathematics and Science Education*
- [13] Hanson, David. M. 2005. Design-Oriented Guided-Inquiry Activities Designing. In *Faculty Guidedbook: A Comprehensive Tool For Improving Faculty Performance*, ed. SW Beyerlein and DK Apple. Lisle, IL: Pacific Crest.
- [14] Jansoon. 2009. Understanding Mental Models of Dilution in Thai Students. *International Journal of Inveromental & Science Education*. Vol 4, No. 2, 147-168.
- [15] Sugiyono, 2011. *Educational Research Methods*. Bandung: Alfabeta.
- [16] Widya Astuti. 2017. *Thesis: Development of Student Worksheets (LKS) for Class Activities and Guided Inquiry Based Laboratories on Acid-Base Materials*. Padang State University, Padang.
- [17] Blanchard, MR, Southerland, SA, Osborne, JW, Sampson, VD, Annetta, LA, & Granger, EM 2010. Is inquiry possible in light of accountability ?: A effectiveness of guided quantitative comparison of the relative inquiry and verification laboratory instruction. *Science Education*, 94 (4), 577-616.
- [18] Dewi, Narni Lestari. 2013. *Effect of Guided Inquiry Learning Model on Scientific Attitudes and Science Learning Outcomes*. Basic Education Journal, 3 (1).
- [19] Hanson, David. M. 2006. *Instructor's Guided to Process-Oriented Guided-Inquiry Learning*. Lisle, IL: Pacific Crest