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THE EFFECTIVENESS OF THE GUIDED INQUIRY ACTIVITY WITH THE ACID-BASE TITRATION MODULE ON THE HIGH SCHOOL STUDENT LEARNING OUTCOMES

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Abstract: The study aims to reveal the effectiveness of guided inquiry activity-based acid-base titration modules on student learning outcomes in class XI MIPA SMA Negeri 2 Batang Anai, Padang, Indonesia. The population is the research sample selected using the purposive sampling technique, where 37 students as research subjects. The research instrument used was a learning outcome test in the form of multiple-choice questions, consisting of a pretest and a posttest. The average value of the increase in student learning outcomes in the subject class is 63.13. Subject class data were normally distributed and homogeneous. The results of the t-test are count (4.18) > table (1.9). The value of N-gain in the subject class is 0.72. The results showed that using the guided inquiry-based acid-base titration module effectively improved student learning outcomes.

Keywords: *Effectiveness, Module, Guided Inquiry, Acid-base Titration, Learning Outcomes*

INTRODUCTION

Chemistry is one of the studied subjects in high school, and the acid-base titration topic is studied in eleventh-grade high school. The scope of the topic is the dimensions of factual, conceptual, and procedural knowledge. Acid-base titration material is a continuation of acid and base materials. The material for acid-base titrations is in the 3.13 basic competency to analyze the results of various acid-base titrations. 4.13 concludes the results of the analysis of the acid and base titration experiment data [1]. Able to analyze is a person's ability to describe a problem or object in its elements. Analyzing relates to the ability of users to distinguish between relevant and irrelevant, determine relationships, and recognize the content organization by analysis [2].

Based on the results of the questionnaire distributed at SMA 2 Batang Anai, information that 90% of students had difficulty understanding the acid and base titration material and difficulties in knowing the equivalence point. Therefore, it is necessary to provide teaching materials in the form of modules to make it easier for students to do exercises and understand concepts.

Learning that can help students is learning that uses a scientific approach. One model that applies a scientific approach and is under the demands of the 2013 curriculum is the inquiry learning model. Part of the inquiry learning model that is effectively used is guided inquiry. In the guided inquiry model, students are allowed to learn to actively develop the ability to think systematically, logically, and critically. For students who are not required to be active in the learning process, when the teacher asks questions in class, the answers given by students are not as expected by the teacher [3]. Kamaruzzaman added that the inactive students have symptoms of a lack of communication, such as being unable to speak, having difficulty opening communication with others, being less a good listener, and lacking concern for what their friends are doing [4]. Apart from being a source of learning, the teacher is a facilitator and motivator in guided inquiry learning [5]. In Abdul Majid's opinion, the direct learning model depends on the teacher's communication style, poor communication tends to result in poor learning, and the direct learning model limits the opportunity for teachers to display many positive communication behaviors [6].

The guided inquiry learning model has five learning stages: orientation, exploration, concept formation, application, and closing [7]. Students are required to be active in the learning process, so teaching materials are needed that support student learning activities. One of the teaching materials that is often used is a module. Modules are classified as teaching materials encouraging students to understand concepts and quickly improve learning effectiveness and efficiency. The guided inquiry-based module was developed based on the stages of the guided inquiry learning model. The module is also under the demands of learning in the 2013 revised 2018 curriculum, which demands teaching materials that involve students searching, processing, constructing, and using knowledge in a learning process [8].

The 2013 revised 2018 curriculum explains that learning is not only the process of distributing knowledge from teachers to students, but they are also asked to think critically, seek, process, and construct knowledge in the learning process [9]. So that students can learn independently and understand the studied concepts [10].

Research on the guided inquiry-based module on acid-base titration material has been carried out by Eka Frima Asda (2020) based on the stages in the guided inquiry learning model consisting of 5 steps, namely orientation, exploration, concept formation, application, and closing [11]. The

guided inquiry-based module developed by Eka Frima Asda (2020) consists of titles, study instructions, essential competencies (KD), competency achievement indicators (GPA), and learning objectives. The module also contains prerequisite knowledge that helps students connect the material they have learned with the material to be studied next.

The module development model used by Eka Frima Asda (2020) is the plump model. This model consists of three stages of development, namely: 1) preliminary research (early investigation stage), 2) prototyping stage (prototyping stage), and 3) assessment phase (assessment stage) [12]. The acid and base titration module has been developed for the assessment phase, where validity and practicality tests have been carried out, but effectiveness tests have not been conducted. The module effectiveness test needs to be carried out to determine the module's effectiveness on student learning outcomes [13].

RESEARCH METHODS

This research is experimental research by testing the effectiveness of the guided inquiry-based acid-base titration module on student learning outcomes. This type of research is Pre-Experimental Design research. The definition of this experiment is research that does not allow or control all variables related to the sample because there are no control variables except for a few variables needed in the study. This research will use one sample class, namely one experimental class. The experimental class is given a pretest before being given treatment. The treatment will use a guided inquiry-based module for class and laboratory activities; after that, it is only given a posttest to see the results after being given treatment. The research design is a One-Group Pretest-Postest Design. This design has a pretest before being given treatment. Thus the results of the treatment can be known more accurately because they can compare with the situation before being given treatment [14].

$$O_1 \; X \; O_2$$

Information:
O1 : Pretest before being given a guided inquiry module.
O2 : The final test (posttest) after being given a guided inquiry module.
Then the influence of the guided inquiry module can be seen from (O2-O1)

RESULTS AND DISCUSSION

Data analysis

Data analysis was carried out before formulating statistical research hypotheses. Before carrying out statistical tests, the normality test and homogeneity test were carried out first on the posttest-pretest value. After that, a t-test was carried out to see whether the hypothesis was accepted or rejected, and an N-gain test was carried out to reveal the module's effectiveness [15].

Normality test

The normality test was conducted to determine whether the data obtained were usually distributed. The normality test was carried out using the Liliefors test so that the L0 and Stable values were obtained at a significant level of 0.05. The normality test was carried out on the posttest-pretest difference data. The results of the normality test can be seen in Table 1.

Table 1. The results of the normality test of the pretest-posttest values for the sample class

Test	A	N	Lo	Lt	Distribusi
Before	0.	37	0.137	0.145	Normal
After	05	37	0.129	0.145	Normal

The table above shows that the subject data has a Lo<Ltable value at a significant level of 0.05. Thus, the posttest-pretest value data for the sample class were normally distributed

Homogeneity test

The homogeneity test was carried out to determine whether the two research data had homogeneous variance or not by using the F test so that the F_{count} and F_{table} values were obtained at a significant level of 0.05. The F test can be seen in Table 2.

Table 2. The results of the homogeneity test of the posttest-pretest value of the subject class

Test	N	S	S^2	F_{count}	F_{tabel}	Categorie
before	37	6.03	36.3	1.37	4.11	Homogenous
After	37	7.06	49.8			

The table above shows the results of the analysis of the homogeneity of variance test carried out on the difference in the posttest-pretest values, obtained Fcount which is 1.37 and Fable is 4.11 so that Fount < Ftable. Thus, the sample class has a homogeneous variance.

Hypothesis test (test the similarity of two averages)

Hypothesis testing is carried out to determine whether the research hypothesis is acceptable. Hypothesis testing is carried out to strengthen the assumptions of the research hypothesis that has been formulated. Hypothesis testing was carried out after the data's normality and homogeneity test of the data. The data on the difference between the pretest and posttest scores in the sample class usually is distributed and has homogeneous variance criteria. Therefore, the two-

average similarity test (t-test) is used to test the hypothesis, which can be briefly seen in table 3.

At the 0.05 level of significance with DK = n1 + n2 -2 = 72 from the distribution table, t(0.05)(72) is 1.99. Ho is accepted if t < t1-α or t < 1.99. Based on the calculation results, the value of count = 41.84, so it can be concluded that Ho is rejected and H1 is accepted.

Table 3. The results of hypothesis testing on the subject's class learning outcomes

Tes	n	X	S2	t-count	t-table
pretest	37	12	36.3609	4.184	1.99
posttest	37	75.13	49.8436		

Gain Normality Test (N-Gain)

The N-Gain test aims to determine the increase in students' conceptual understanding of the material studied before and after the learning process based on the results of the pretest and posttest in the sample class. The average value of the pretest learning outcomes in the experimental class is 12.00, and the average posttest score is 75.13, with an average N-Gain of 0.72. It means that the learning outcomes in the experimental class have increased in the high category, which means that the use of the guided inquiry-based acid and base titration module is effectively used to improve student learning outcomes.

Students who study using guided inquiry-based modules can learn independently because the module contains steps according to the guided inquiry learning model, which consists of 5 stages: orientation, exploration, concept formation, application, and closing. The modules used are also under the scientific approach, which demands the 2013 curriculum.

The greater the success of a module after implementation, the more effective the learning process using the module will be. The optimal learning process correlates with students' learning outcomes who build their own knowledge through various stimuli and carrying capacity [16].

The first stage, namely the orientation stage, is the initial stage to prepare students to learn. Students gain initial knowledge in the form of learning objectives, the motivation that can build interest and arouse student curiosity, and apperception, namely prior knowledge related to the knowledge to be studied, which is obtained from guided inquiry-based modules.

The next stage, exploration and concept formation, are two interrelated stages. At this exploration stage, students observe pictures, models, or tables. This activity is under the stages in the scientific approach, namely observing, where students read, hear, listen and see (without or with tools) to practice seriousness, thoroughness, and seeking information [17].

Students analyze data or information through critical questions that can lead students to learn independently and find their concepts. Students can also ask the teacher about key questions or subject matter that is not understood. This activity follows the scientific approach, namely asking questions. Through questioning activities, students can develop creativity and curiosity to obtain information to find concepts [18].

The concept formation stage is where students form concepts through previous exploration activities. The concept is found, introduced, and formed through questions that can make students think critically and analytically. Students must be able to think critically and analytically so that learning can occur well. Critical thinking is a skill that students must possess.

Students can find concepts in exploration and concept formation activities because students observe and read guided inquiry-based modules, hear explanations from the teacher, answer questions asked, conduct group learning activities (discussion) and conclude the results of the discussions obtained so that students find the concept independently. Independent because learning is doing, gaining specific experiences under the expected goals.

The next stage is the application stage, where students are given practice questions so that student understanding is more robust and trains students' abilities to solve problems related to concepts that have been obtained previously. When the concepts applied in practice questions are successful, students can integrate them with other concepts.

The last stage is the closing stage, where students convey the results of group discussions based on the material they have learned. Students from other groups gave rebuttals, responses, and input. The teacher provides input and confirms the results of student discussions. This stage is under the stage of communicating on a scientific approach, where students convey the results of observations that have been carried out both orally and in writing and make conclusions based on the results of the analysis so that students have good and correct language skills.

The guided inquiry-based acid-base titration module is equipped with multiple representations (macroscopic, sub-macroscopic, and symbolic levels) to make it easier for students to learn concrete and abstract material. At the microscopic level, students can observe fundamental changes, such as color changes in chemical reactions [19].

The module has an attractive color display, equipped with pictures, tables, learning information, questions, and practice questions that make learning easier for students. The success of presenting the material with the module is primarily determined by the colors, letters, and boxes that attract students' attention.

The obstacle faced during the research was the ineffectiveness of each step of guided inquiry learning because, at each step, it took a long time for students to understand the learning, so the researchers lacked teaching time. However, researchers are trying to control the time better so that learning can run properly. The efficiency of study time has been used as a good time. The module's benefits are accompanied by models that attract student motivation in learning [20].

CONCLUSION

The guided inquiry-based acid-base titration module is effective in enhancing student learning outcomes. The N-Gain value obtained when using the guided inquiry-based acid-base titration module is 0.72 with a high category, and the results of the t-test at a significant level of 0.05 are tcount (4.18) > ttable (1.9), so Ho is rejected, and H1 is accepted. Thus the research hypothesis is accepted. In conclusion, the guided inquiry-based acid-base titration module effectively improves student learning outcomes in class XI SMA 2 Batang Anai, Padang, Indonesia.

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