THE EFFECT OF APPLICATION OF INQUIRY-BASED STUDENT WORKSHEETS ON ACID-BASE TITRATION MATERIALS ON STUDENT PERFORMANCE AND LEARNING OUTCOMES

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Abstract

Experiments an important role in improving the performance skills (psychomotor) and learning outcomes (cognitive) of students. Some studies results show that the performance and learning outcomes of students are not maximized due to the limited learning media that can also act as a practical guide. Learning media innovation is needed to overcome these problems. This study aims to determine the effect of the application of inquiry-based worksheets on improving performance and learning outcomes. Sample of this research were students of class XI MIPA which were divided into experimental and control classes with a total of 62 people. The research was conducted in the even semester of the 2020/2021 academic year at one of the senior high schools in Aceh Besar District. The research instrument consisted of an observation sheet to measure performance aspects, and test questions for learning outcomes. Data were analyzed by analysis of covariance (ANCOVA) using SPSS 17.0 software for windows at a significant level of 0.05. The results show that the application of inquiry-based worksheets can improve student performance and learning outcomes

Keywords: inquiry-based worksheets, performance, learning outcomes

INTRODUCTION

Practicum in the laboratory is an integral part of science learning. The implementation of the practicum that connects the theoretical and practical aspects is expected to have an influence on students on the achievement of performance skills (psychomotor), scientific attitudes (affective) and understanding of concepts (cognitive). (Merdekawati, 2017; Nainggolan, dkk., 2020). Performance skills are described as activities that students do such as using laboratory equipment, cleaning equipment, observing and measuring for data collection purposes (Muhtasib, 2019).

Maximum learning outcomes will be obtained if the presentation of material in class is combined with practicum (Orbe, dkk., 2018). The quality and success of a teaching and learning process (PBM) is determined by many factors, one of which is the learning media used. Good learning media can improve students' skills in solving problems, practicing collaboration, communication and training critical thinking to create new things (Lay & Osman, 2018). The use of good learning media will direct learning to be more effective and fun (Ghavifekr & Rosdy, 2015).

The results of observations during learning were found that students only used textbooks as learning resources. This finding is reinforced by the statement of the chemistry teacher interviewed, concluding that the main learning resource is the student handbook. The results of interviews conducted with students of SMA Negeri 1 Seulimeum class XI MIPA also stated that they had difficulty understanding concepts and had not been able to relate chemical material to phenomena that occur in everyday life. The limited learning media makes PBM only guided by one source. This causes students to be less actively involved in learning so that their understanding of concepts and performance skills is low (Astuti, dkk., 2019).

One of the class XI subject matter is acid-base titration which includes solution composition, reaction equations, ionization reactions and chemical equilibrium. (Supatmi, dkk., 2019). Acid-base titration is included in the National Examination (UN) material whose value is below the average. The UN value data, especially on acid-base titration material in 2017, 2018 and 2019 respectively, were 31.41%, 43.37%, 42.25% (Puspendik, 2017; Puspendik, 2018; Puspendik, 2019). The low learning outcomes of chemistry in this material are also evidenced by the test scores being below the minimum completeness criteria (KKM) set by the school, which is 75.

Direct observation through practical activities in the laboratory allows students to explain chemically events that occur in their daily environment (Imaduddin & Hidayah, 2019; Gupta, dkk., 2015). Practicum can also improve students' skills because they are required to solve problems, analyze facts and find their own concepts as a result of the treatment and observations they make. (Sujarittam, dkk., 2019; Duda, dkk., 2019).

Practical activities generally consist of three stages: pre practicum, core practicum and post practicum. Pre practicum is the stage of preparing materials and tools and designing work plans. The core practicum stage consists of carrying out experiments according to the work plan made. The post practicum stages consist of analyzing, writing and concluding the results of the experiment (Saraswati & Mertayasa, 2020). Learning in class and practicum results will be more effective if it is equipped with learning media that also acts as a guide. This learning media is arranged in a clear and systematic manner to facilitate what activities must be carried out.

The performance and learning outcomes of students can be increased with the additional learning media, namely inquiry-based worksheets. Students explore knowledge by looking for answers to the questions given and writing them down based on their own observations (Fahrurrizal, dkk., 2019; Utari, dkk., 2018). Students are directed to carry out learning activities that aim to stimulate their curiosity in digging up information on the problems given (Nazar, dkk., 2018).

Several studies on inquiry-based worksheets in learning have been carried out by (Andromeda, dkk., 2017; Damaianti, dkk., 2019; Saidaturrahmi, dkk., 2019; Muskita, dkk., 2020; Kaya & Avan, 2020; Nunaki, dkk., 2019; Wildan, dkk., 2019; Kadir, dkk., 2017). The research was limited to inquiry-based worksheets which only contained reading descriptions and pictures about the material. The literature that has been explored so far has not found inquiry-based worksheets that contain content such as videos, animations, readings and questions that must be done by students, especially on acid-base titration material. The videos, animations, readings and questions can be obtained by students by scanning the barcode contained therein

Based on these problems, a research was conducted on the Effect of Inquiry-Based SW (IBSW) Application on Acid-Base Titration Materials on the Performance and Learning Outcomes of High School Students.

RESEARCH METHODS

The research method used is quasi-experimental with a pretest-posttest non-equivalent control group design. The approach used is a quantitative approach. The research design can be seen in Table 1 (Sugiyono, 2014). The research sample was 62 students, from class XI MIPA 1 as the experimental class and XI MIPA 2 as the control group. The experimental class studied using inquiry-based worksheets, while the control class only used textbooks. This research was conducted at SMA Negeri 1 Seulimeum, Aceh Besar Regency in March in the even semester of the 2020/2021 academic year. The parameters measured are performance and learning outcomes. Performance data were obtained through observation sheets and learning outcomes through the objective test instrument of 20 items which were carried out through pretest and posttest activities.

Tabel-1. Pretest-Posttest Non-Equivalent Control Group Design

Kelompok	Pretest	Perlakuan	Posttest
Experimental Class	P1	X1	P2
Control Class	K1	X2	K2

3. DATA AND ANALYSIS

Student learning outcomes data were analyzed by statistical test of covariance analysis (ANCOVA), while the performance is calculated through the equation $P = \frac{f}{n} \times 100\%$ (Sudijono, 2012).

4. RESULTS AND DISCUSSION

4.1. Performance

Performance appraisal is one of the non-test assessments with data obtained based on observation sheets whose filler is called observer. Performance assessment requires a rubric to assess the quality of the student's performance. Observation sheets and rubrics before use are validated in order to determine the feasibility, and provide suggestions and input if needed for improvement. Validation is carried out by two experts in their field.

The performance of the students was observed by five observers, each of whom supervised a study group of 6 people. The implementation of the practicum was carried out at the second meeting, while the previous meeting took place in class. The first meeting learned about the concentration of solutions, the basic concepts of titration and the introduction of titration equipment. The second meeting was carried out with practicum to answer the problems that had been given at the first meeting. The titration experiment consisted of three parts: strong acid - strong base (SA-SB), strong acid - weak base (SA-WB) and weak acid - strong base (WA-SB).

Performance data is obtained by supervising students in carrying out certain activities. Student performance is observed in 3 stages, pre practicum, core practicum and post practicum. Its components include: preparing tools and materials needed for experiments, skills in using equipment, observing and writing results, and communicating practical results. The recapitulation of student performance data at three stages is contained in Table 2.

Table 2. Recapitulation of Student Performance

No.	Stages	Main components observed	Performance (%)	
			Exp. Class	Control Class
1.	Pre practicum	Prepare the tools and materials needed for the experiment as stated in the Student Worksheets	67,20	62,90
2.	Main Practicum	Skills in using practical equipment	71,64	70,43
3.		Observing and writing observations	78,49	75,81
4.	Post-Practicum	Communicating practicum results through group presentations	65,59	65,59
Mean			70,73	68,68

Based on Table 2, it can be seen that the average value of the performance of the experimental class is better than the control class. The skill of using experimental class practicum equipment is higher than the control class with a comparison of 71.64 and 70.43. The experimental class is class XI MIPA 1, which is given an inquiry-based SW containing guidelines and how to use laboratory equipment. The guide can be

obtained by students by scanning the barcode contained in certain sections in the student worksheets using a device. Scanning the barcode will direct students to a video that explains in detail how to use the equipment in the laboratory properly. Watching videos makes it easier for students to understand concepts and how the practicum works because they see firsthand the phenomena and their explanations compared to just reading (Wilujeng, dkk., 2020). The video was prepared by the researcher, containing instructors who were carried out by expert laboratories with systematic and detailed practicum implementation steps. A good practicum instructor video contains content such as the objectives to be achieved, implementation tutorials, questions and the relevance of experiments to everyday life. (Martin, 2019).

Performance skills are influenced by many things, including the experience of students. The experience in question is the initial ability, where in the material before acid-base titrations, other materials have been studied that can be put into practice. (Torres, 2018). In addition, in class X, special materials have been studied regarding the tools in the laboratory and how to use them. This basis is not only a basis for each student, but also an additional exercise for those who are carrying out acid-base titration practicum.

4.2. Learning Outcomes

Data on student learning outcomes in this study can be seen from the pretest, posttest and N-Gain scores. Learning outcomes data are loaded in Figure 1

Figure 1. Data Value of Pretest, Posttest and N-Gain

Figure 1 shows the results of the pretest between the experimental and control classes of 40.81 and 42.42. This proves that the two classes have almost the same level of knowledge. Different results were obtained at the posttest, the experimental class had a better score than the control class with a comparison of 71.13 and 62.10. In general, it can be concluded that the provision of inquiry-based SW to the experimental class has a positive impact on learning outcomes when compared to the control class which only uses textbooks. The N-Gain value data shows that between the two classes, which group experienced a higher increase in learning outcomes based on the pretest and posttest scores. The improvement in learning outcomes was better in the experimental class with an N-Gain value of 61.47 compared to the control class with a value of 52.53.

The different results obtained were estimated by the different treatments received by the two classes. The control class did not get an inquiry-based SW like the experimental class. This resulted in the level of understanding of concepts between the two classes received during learning to be different. The control class only obtained material from the student handbooks they had with them. The experimental class received additional reading from the textbook and also the inquiry-based SW given. The advantage of the inquiry-based SW given to the experimental class is that there is an additional learning video about acid-base titration that they can see by scanning the barcode. This creates a new learning atmosphere for students, because in handbooks such features are rarely found.

Videos related to the subject matter are very helpful for students in understanding the lesson. Information about learning materials that they usually get only from reading, is now increasing with the help of videos. One of the advantages of learning videos is that they can be played back when students find concepts that are difficult for them to understand (Slemmons, dkk., 2018). The increase in learning outcomes before and after the administration of inquiry-based SW can be determined by ANCOVA statistical analysis. The results

of statistical analysis can be seen in Table 3.

Tabel 3. Covariance Analysis

Sources of Varian	Sum of Squares corrected	dk	Corrected Average Number of Squares	Fcount	Ftable (0,05) dk=1:59
Between Treatments	1426,4607	1	1426,4607	17,51	4,00
Galat-Y	4805,6840	59	81,45		
Total	6232.1447	60			

The results of ANCOVA obtained that Fcount is 17.51 and Ftable ($\alpha=0.05$; dk=1:59) is 4.00. Fcount > Ftable (17.51 > 4.00) it can be concluded that there is a significant difference in student learning outcomes between the experimental class and the control class.

The results prove the statistical hypothesis H_a : there is a difference in learning outcomes between the experimental class and the accepted control class. The acceptance of the statistical hypothesis (H_a), the research hypothesis (H_r) that the application of inquiry-based SW has an effect on learning outcomes is also accepted. The conclusion that can be drawn is that the application of inquiry-based SW has an effect or influence on student learning outcomes. The dependent variable analysis obtained sig. 0,561 > =0,05 this explains that the posttest is only influenced by treatment, namely the result of giving inquiry-based SW.

Learning in the classroom today should be able to guide students to be responsive in the use of technology to support more effective results. The use of technology in education is a necessity to support independent, creative and quality learning. In addition to the use of technology, it is also necessary to support learning media that are suitable for SW, for example. Commonly encountered SWs are usually in the form of a set of printed materials containing a description of the material. Along with the development of technology, now it has changed its form to be more flexible, for example it is in the form of softcopy that does not need to be printed, and can be read through a smartphone. Including the SW used in this study, it can be scanned in certain sections to view videos related to the material being studied. The use of SW in learning is very important because it can provide opportunities for students to be active in learning. This is based on the stages contained in the SW to guide students to understand the concept being studied (Sya'idah, dkk., 2020). This step will make students creative, innovative, clever in solving the problems they face (Curtis, dkk., 2020).

5. CONCLUSION

Based on the results of the research that has been described, it can be concluded that the performance skills of students can increase with the help of existing guidelines on inquiry-based SW, and the use of inquiry-based SW in learning can improve student learning outcomes on acid-base titration material.

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