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THE USE OF VIRTUAL LABORATORY OF ACID-BASE MATERIALS TO IMPROVE STUDENTS LEARNING OUTCOME

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ABSTRACT

This study aimed to determine how much animation-assisted learning can improve students' learning outcomes in chemistry subjects, especially acid-base solution. This research is a type of classroom action research. Research subjects are 33 students' of 2th Vocational High School Cimahi grade X Multimedia C on the academic year 2019-2020. Data collection techniques using written test questions, questionnaires, and observations. The method of classroom action research is taken in two cycles. Each cycle has four stages, which consist of planning, implementation, observation, and reflection. This class of research took place from September 2019 to December 2019. The percentage of class learning completeness obtained through written tests in the first cycle was 72.73% (74.55% class average) and 87.87% for the second cycle (average grade 77.57%). Thus, it can be concluded that the use of animation can improve student learning outcomes in chemistry subjects in acid-base solutions.

Keywords: acid-base solution, action class research, learning outcomes, virtual laboratory

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1. INTRODUCTION

According to *Undang-Undang Dasar No. 20* in 2003 on the National Education System, Vocational High School (*SMK*) defined as: "vocational education is an education that prepares students' to be able to work in a particular field. Vocational High School is an education whose purpose is to have relationship with technological developments. This is because vocational schools are the earliest level schools equivalent to high schools that provide vocational supplies in the form of skills related to technology. In addition to preparing a professional workforce. The purpose of vocational education also prepares students' to be able to continue their education to a higher level in accordance with vocational programs or areas of expertise" (Jaya, 2012). In the implementation of Curriculum 2013 refers to Permendikbud No. 64 in 2013 on Content Standards, it is expected that students' are more active in following the learning process, while teachers act as facilitators. Learning with approach process is carried out by involving student activities. The discovery and development of facts, concepts and principles of science can be completed by involving students' in the learning process (Burhanudin et al., 2018).

The development of students' ability to find and develop facts, concepts, and principles of science has not been able to show the expected results because learning in schools is still not able to apply the principles of implementing of the Curriculum 2013 maximally. Vocational High School 2 Cimahi is one of the vocational schools that has implemented the Curriculum 2013, but still cannot implement it maximally. Based on the observation results, the chemistry learning process has been applied quite well, by providing opportunities for students' to learn independently (student centered) where learning has been applied problem based-

learning model however students' have not fully learned actively, and effectively. Students' still look passive on some learning activities such as discussions question and answer with teachers.

Not maximum implementation can be seen from the students' learning outcomes in chemistry learning, it is shown that 21 students' from 33 students' in 11th grade Multimedia C get score below *KKM* (*Kriteria Ketuntasan Minimum* / Minimum Completeness Criteria), it is ≥ 75 in cognitive area learning results. Based on these findings, it can be said that the results of student chemistry learning in the class is low because the characteristics of chemistry itself are mostly abstract (Kean and Middle camp in Tubagus, 2016), so it is necessary to explore a tool containing verbal systems and images as described dual coding theory that means multimedia can further concrete the abstract concepts (Yuliani et al., 2017).

Abstract concepts are inseparable from the material of acid-base solution. Learning of this material is carried out in class X Multimedia C with Basic competency 3.6. Analysis the properties of the solution based on the concept of acid-base and pH solution (strong acids and weak acids, strong bases and weak bases) in daily life and basic Competence 4.6. Compare the properties of solution properties through practicum based on the concept of alkaline acid and solution pH (strong acids and weak acids, strong bases and weak bases) in daily life.

The material of the acid-base solution learns about the solution based on the strength of the acid-base, calculates the concentration and pH of the solution. Acid-base solution is very closely related to daily life, so this material is extremely important to be studied and understood, but in reality students' are just memorizing without understanding the material in depth.

In order for students' depth understanding the material, it is necessary to concentrate abstract concepts on chemistry learning by using learning media that makes the condition more interesting and the material delivered by the teacher is easy for students' to understand. Arsyad (2011) stated that the role of media in learning can occur by involving the mental activities of students' so that information can be obtained. Najjar (1966) said that the media is effective in the process of helping a person in the learning process.

The media has the ability to combine person's way of understanding, organizing, and accessing information. From the results of Haryati's Ressearch et al., (2013) concluded that learning media can increase students' learning motivation and can stimulate students' considering what has been learned and also provide stimulation to new learning materials, therefore it requires interesting media.

Interestingly packaged learning is expected to provide different and effective learning atmosphere for learners but the main thing is to help learners understand chemicals (Argandi et al., 2013). In the learning process we need to choose media that is suitable, appropriate and worthy using.

Various factors that influence students' through the use of media are psychology, learning readiness, and mastery of children. Therefore, teachers as facilitators need to learn how to establish learning media in order to have effectively achieve learning objectives in the teaching and learning process (Prawiro, 2012). By using media in the learning process, chemistry become more fun and easy to understand by students'.

Virtual laboratory is one of the interesting media alternatives for learners. One of the ways to improve learning outcomes can be used virtual laboratories. Virtual laboratory is one of the interesting media alternatives for learners in learning Chemistry. The advantages of virtual laboratory is to support the conceptual understanding of students' at the sub-microscopic level, can be used linearly or nonlinearly by selecting the desired menu, it makes efficiently tools, materials and time even though simulations are carried out as often as students' want (Muhson, 2019).

Kafrawi (2018) in his class action research (PTK) at 11th Vocational High School 1 Labuhanhaji showed that in the observation of student activities there was enhancement by applying interactive multimedia-based virtual laboratory media, this can be seen from 75% in cycle I and 90% in cycle II, while the completeness of students' learning outcomes can be shown through tests carried out in each cycle, 71% in cycle I and 91% in cycle II, it is concluded that the application of virtual laboratory media based on interactive multimedia on colloidal system material can improve response and the completeness of students' learning outcomes in colloidal system materials based on interactive multimedia at Vocational High School 1 Labuhanhaji.

The previous researches showed the use of virtual laboratory in chemical learning in some chemical materials delivered colloids and acid bases but for the acid bases has not been applied in the form of class action research with virtual laboratory Phet Simulation, so the purpose of this study is to describe the activities of students' in chemical learning on acid base solution materials using virtual laboratory and Phet and analyze the improvement of learning outcomes of students' in 10th grade Multimedia C of Vocational High Shool 2 Cimahi after learning using virtual laboratory Phet on acid-base solution material.

2. RESEARCH METHOD

This research was conducted using class action research method. Class Action Research is research which aiming to find something basic practical knowledge in order to improve circumstances or situations that are carried out on a limited basis (Wiersma, 2009). Class action research is carried out in ongoing situation, with the implementation stages of two cycles with each cycle consists 2 meetings. Test results of each cycle are analyzed to find out the extent of the effectiveness of chemical learning in acid-base solution material.

The research data obtained from students' of Multimedia A in class X amounted to 33 people, consisting of 23 men and 10 women. The data obtained is overview of the learning process in Chemistry subjects in class X Multimedia C. In fact, the steps of PTK Kemmis and Taggart models are cycles with each cycle consists of four components, consist of planning, implementation (action), observation (observation) and reflection that is seen as one cycle. The amount of cycles in PTK depends on the problems that need to be solved.

It generally occurs more than one cycle. Nowadays, PTK developed and implemented by teachers in schools is generally based on the model of PTK Kemmis and McTaggartini. The research chart according to Kemmis and Taggart (Arikunto, 2006) as follows:

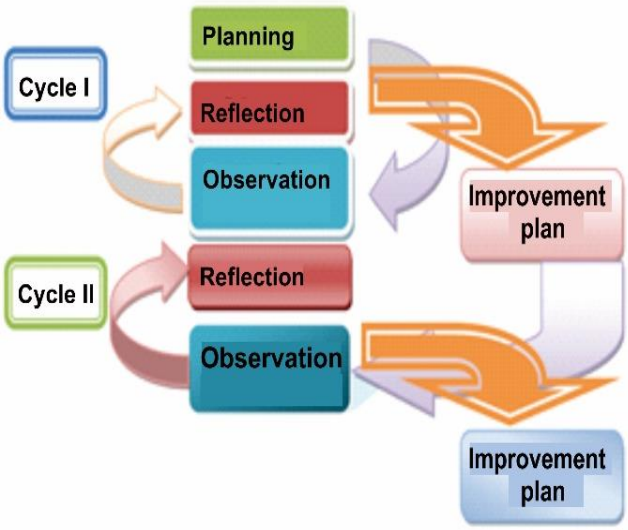

Figure 1. Draft Chart of Implementation of PTK Spiral Model (Arikunto, 2006).

Based on the research flow, the research instruments used in this study are grouped into instruments for preparation, implementation, and evaluation stages of learning outcomes.

Learning is carried out in two cycles. Each cycle is held in two meetings. The time allocation per meeting is 3 x 45 minutes. Evaluation Stage using written test instruments (initial test and final test), giving questions. Test results in cycle I and cycle II are processed with the following steps:

a) Calculating the value of students' learning outcomes using a formula (Purwanto, 2010):

The instruments at the implementation stage is learning lesson plan. This learning lesson plan is used as a teacher's instruction in learning process activities to achieve teaching objectives carried out in one subject.

Learning steps with scientific methods include observing, interpreting, collecting data, associating, and communicating implemented into main-activity steps within the *learning lesson plan*.

Data collection obtained from student worksheet used by learners during learning and observation sheet used by observers during learning process.

$$\text{Final Score} = \frac{\text{Students' Score Obtained}}{\text{Maximun Score}} \text{ x } 100\%$$

b) Create an individual completeness table (absorption). Final Score Criteria (NA) ≥ 75, students' are considered complete the score/students' total score is ≥ 75.

Calculating class completeness using a formula (Purwanto, 2010)

$$\text{Completeness} = \frac{\text{Total Score} \geq 75}{\text{Total Students}} \text{ x } 100\%$$

Class Criteria ≥85%, class is considered complete. Data obtained from observations is processed into percentage values, with a formula (Purwanto, 2010)

$$P = \frac{Q}{R} x\ 100\%$$

Description:
P = Percentage of components observed
Q= Total of students' doing activities
R = Total number of students'

3. RESULT AND DISCUSSION

In this research, it has been carried out the development of several aspects, among others; (1) Phet simulation from the university of Colorado, where learning is assisted by interactive simulation of acid base solution (2) Evaluation technique, which is carried out at the end of each action cycle to examine learners' learning achievements and as reference in the implementation of improvement in the next cycle.

3.1. Cycle I

Cycle I progresses 2 x 3 x 45 minutes or two meetings. The materials taught in this learning process are the Definitions, Properties, and and Theories of Acids and Bases.

Table 1. Results of Observation of Student Activities in Learning With The Help of Virtual Laboratory Cycle I

No.	Observed components	Total	%
1.	Observe the animation/virtual lab presented by the teacher.	20	60.60
2.	Make the questions from being observed and try to make the answers temporary.	15	45.45
3.	Active in collecting information to solve problems	24	72.72
4.	Having spirit to collecting data processed from information	28	84.85
5.	Communicative in presenting the results of problem solving.	30	90.91

From Table 1. information obtained that 20 students' (60.60%) make observations on the virtual lab presented by the teacher. 15 people (45.45 %) make inquiries from the observed and tried to make temporary answer, 24 people (72.72%) seemed very active gathering information and 28 people (84.85%) seemed eager in processing the data collected information, and 30 students' (90.91%) are very communicative in presenting their findings.

The initial test results give idea of the extent of learner's cognitive abilities before being given virtual laboratory shows that all learners score under the *KKM*. Meanwhile, the final test results of 2 students' from 33 students'

received a score of ≥ 75. Comparison of initial test results and final test results is more clearly illustrated in Figure 2.

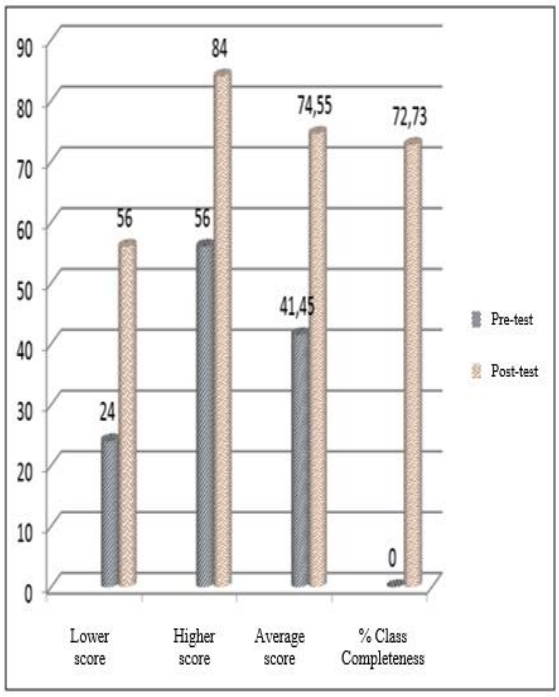

Figure 2. Comparison Chart of Student Learning Outcomes Improvement in Cycles I

Based on Figure 2, it can be seen the improvement of learning results using the initial test data and the final test with multiple choice question type as many as 25 questions. In the students' answer sheet (initial test and final test) written that the result are processed by giving grades adjusted to the assessment of the curriculum 2013, namely in grades 0-100 with two numbers behind the comma, then determined the average of the initial test and the final test of each group of learners, then determined the percentage of class completeness.

Based on Figure 2 obtained that the analysis results of each students' activities in learning has not shown satisfactory results, because there are still students' who have score under 75 which is about 27.27%. This is partly because the learners are not used to learning through learning methods with the assistance of virtual lab simulation phet where in the learning process there are many students' who are confused how to observe, what to observe, and how to describe the results of observations related to acid base solution material and discuss the results. In addition, there are some students' who still exhibit unwanted behavior as seen in Table 2.

Table 2. Learner Activity Observation Data Table with Behavioral Activities

No.	Observed components	Total	%
1.	Talking with friends	7	21.21
2.	Disturbing friends	5	15.15
3.	In and out of class	4	12.12
4.	Sleepy	2	6.06
5.	Playing games with friends	8	24.24

Table 2 informs that there are still quite lot of participants who talking during learning (21.21%), go in and out of class (12.12%), like to play games both in learning and practicum (24.24%), and like to disturb their friends who are studying (15.15%).

Figure 2 showed when the initial test was held on the learners, there is no one of the learners who got the grades that corcodance with the *KKM* that has been set by the school , the highest score was only at 56 while the lowest score is at 24, this is understandable because the learners have not received learning with animated media rocks after the learning process in cycle I is completed, then at the end of the cycle is carried out the final test (cognitive) to find out the ability of learners in absorbing the material that has been discussed.

From Table 4.1. there was a significant improvement in the final test results where from 33 students' there were 24 learners (72.73%) who can complete learning with the lowest score is 56 and the highest score is 84.

The average score obtained by students' from formative test results in the first cyclewas 74.55 with only 24 students' who met the

school-defined learning completeness criteria (grade ≥75). When it controlled from classical learning completeness, the results of actions in the first cycle have not shown satisfactory success because it is still below 85%. The value of learning outcomes achieved in the first cycle has not met the indicators of success of the desired action (85% of learners ≥75).

Based on the results of observations on teachers and reflections on the first cycle, it was obtained that: (1) learning activities are still dominated by teachers, teachers do not give many opportunities for learners to think for themselves in finding new concepts; (2) learners still seem less eager in discussing and questioning, because learning with the help of animation of learners has never been implemented; (3) teachers do not give enough time to students' to ask questions.

But the most important of all above analysis is that learning with the assistance of virtual laboratory simulation phet on acid base solution material can improve learning outcomes of learners proven with an average initial test score of 56 to 84, in the final test more than half of the learners get a score of 75 after learning with the help of animation this is as stated Widodo & Vidia (2006), practicum through simulation virtual laboratory, has been fairly represented, this is due to some pragmatic skills such as observing and analyzing skills or which is one of the important parts that can be obtained from virtual laboratory simulations. By evaluating the activities and learning outcomes obtained in cycle I, there needs to be improvement in carrying out cycle II, among others by more motivating and attracting the attention of learners.

3.2. Cycle II

Cycle II occurs about 2 x 3 x 45 minutes or two meetings. The material taught in this learning process is acid-base classification. The learning process takes place as cycle I with the improvement of several learning techniques according to the results of reflections on cycle I. This learning is used several phet simulation of acid base solution.

Data of students' activities in the learning process in cycle II is obtained from observations. From Table 3. information obtained that 33 students' (100%) observing the virtual lab presented by teachers, 25 students' (75.75%) made the questions from being observed and tried to make temporary answers, 22 students' (81.81%) seemed very active in collecting information and seemed eager in processing information collection data (90.91%), and 31 students' (93.94%) are very communicative in presenting its findings.

Analysis of each students' activities in learning is quite satisfactory, because it is above 50% of the learners from two learning meetings with virtual laboratory-assisted learning. This is partly because the learners have become accustomed to learning through virtual laboratory-assisted learning methods where in the learning process there are many learners who can already try to solve problems related to the classification of acid-base.

Table 3. Results of Observation of Student Activities in Learning with the help of Virtual Laboratory Cycle II

No.	Observed components	Total	%
1.	Observe the animation/virtual lab presented by the teacher.	33	100
2.	Make the questions from being observed and try to make the answers temporary.	25	75.75
3.	Active in collecting information to solve problems.	22	81.81
4.	Having spirit to collecting data processed from information	30	90.91
5.	Communicative in presenting the results of problem solving.	31	93.94

The Formative test conducted at the end of cycle II is to find out the ability of students' mastery materials that has been discussed, the total of students' who meet the criteria of minimum completeness criteria set by the school with grades≥ 75 is 87.87%, this completeness shows satisfactory results. The

value of learning outcomes achieved in the second cycle when compared to the average value of learning outcomes achieved by students' in the first cycle, increased by 13.31%.

Learners showed considerable fascination and curiosity over the material discussed. Treatment in cycle I is also carried out in cycle II. Evaluation in the second cycle using 25 questions of multiple choice (initial test and final test), it is processed by means of giving score in accordance with the assessment of the curriculum 2013, then determined the average of the initial test and final test of each group of learners, and subsequently determined the percentage of completion of the class.

Comparison of preliminary test results and final test results is described more clearly in Figure 3. From the results obtained in cycle II shows that minimum completeness criteria has been achieved, when reviewed in terms of improving student learning outcomes and activities from cycle I to cycle II. This is partly because students' have become accustomed to assisted learning, furthermore it can make easier to understand the chemical concepts of colloidal system materials and teachers in the learning process act as facilitators.

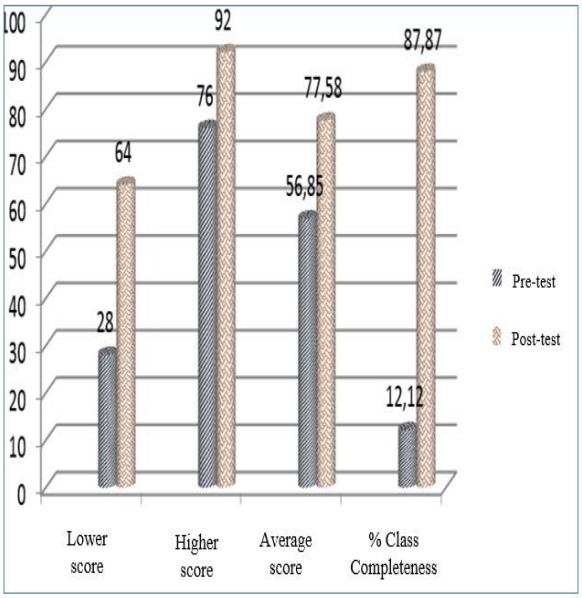

Figure 3. Comparison Chart of Student Learning Outcomes Improvement in Cycle II

Based on the observations and reflections made by all the research team stated that learning in cycle II has been able to overcome weaknesses in the first cycle, such as: (1) teachers have given enough time to students' to answer questions; (2) teachers have provided sufficient motivation and strengthening to students'; (3) teachers have been maximally guiding students' in drawing conclusions. Overall, it can be said that the application of learning assisted the development of learning through virtual laboratory phet simulation can improve the learning outcomes of learners both from cycle I to cycle II.

Based on the results of the study, it can be said that virtual laboratory assisted learning in the study of acid base solution material in class X Multimedia C can improve student learning outcomes, so it can also be said that the learning that takes place is quite effective Improvement of learning outcomes is due to virtual learning by assisting virtual laboratories that have the ability to make learning interesting so as to increase the motivation of students' in enjoying the learning carried out this as stated by (Rizkiana et al. , 2018; Ikhsan & Afdal, 2016) resulting in better average values than control classes (Argandi Research et al., 2013).

4. CONCLUSION

The application of virtual laboratory-assisted learning in acid-base solution materials can overcome learning difficulties of students' in class X Multimedia C, and can improve student learning outcomes. This is demonstrated by the increase in class average in cycle I is 74.54, by showing learning completeness is about 72.73%, while the average grade value in cycle II is 77.50 with learning completeness is 87.85%.

Students' response to the learning implementation with the assistance of animation showed positive improvement, as seen from the observation data with less unwanted things in the classroom and visible from the activeness of students' in the classroom.

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