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Application of the e-Module Assisted Problem Based Learning Model to the Education Outcomes and Interests of Class XI Students in Material Buffer Solution

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Abstract:The study aims to describe the problem based learning model in buffer solution material to improve education outcomes and interests of Class XI Students in Materia Buffer Solutions. The sample in this study was taken in two classes namely the examination class which used a problem based learning model assisted by the e-module and the standard class which used a direct instruction model assisted by the e-module. Purposive sampling was used to collect sample. The instrument in this study was a multiple choice test with 20 questions and a non-test instrument with 30 statements. From the research results, it was obtained that the n-gain posttest in the examination class was 0.820 in the high category and interest in learning after being given treatment in the examination class was 0.207 in the low category. Thus, it can be concluded that problem-based learning model can improve education outcomes and learning interests

Keywords: Buffer Solutions, Problem Based Learning, Education Outcomes, Learning Interests, e-Modules.

Abstrak:*Penelitian ini bertujuan untuk mendeskripsikan model pembelajaran probem based learning pada materi larutan penyangga untuk meningkatkan hasil dan minat beajar. Sampel pada penelitian ini diambil dua kelas yaitu kelas eksperimen yang dibelajarkan menggunakan model pembelajaran problem based learning berbantuan e-modul dan kelas kontrol yang dibelajarkan menggunakan model pembelajaran direct instruction berbantuan e-modul. Pengambilan sampel dilakukan dengan purposive sampling. Instrumen pada penelitian ini berupa instrumen tes soal pilihan berganda sebanyak 20 soal dan instrumen non-tes sebanyak 30 pernyataan. Dari hasil penelitian diperoleh n-gain posttest di kelas eksperimen sebesar 0,820 pada kategori tinggi dan minat belajar setelah diberikan perlakuan pada kelas eksperimen sebesar 0,207 pada kategori rendah. Dengan demikian, dapat disimpulkan bahwa model pembelajaran problem based learning dapat meningkatkan hasil dan minat belajar siswa.*

Kata kunci: *Larutan Penyangga, Problem Based Learning, Hasil Belajar, Minat Belajar, e-Modul.*

▪ INTRODUCTION

Chemistry is a concept obtained from facts and various previous experiments. More often students prefer memorization rather than understanding the process that occurs (Berutu, 2022). In essence, science consists of products, processes, and scientific attitudes (Hernita et al., 2019).Chemistry as a product includes a collection of know-how such as facts, concepts, and standards that need to be owned to collect and increase chemical knowledge. Chemistry as process consists of capabilities and attitudes to collect and increase chemical expertise (Suswati, 2021). Each topic of chemistry lessons, must have a different level of difficulty for each student. Some have high, medium and low difficulty levels for students to understand. The difficulty level of each chemistry subject needs to be further reviewed to find a better solution in the future. Especially helping teachers in carrying out the coaching and mastering system. Because each subject in chemistry lessons has a different level of difficulty, the level of student understanding of each subject in chemistry lessons also varies, this relies upon on the manner of teaching method and media used to carry out the learning (Herlina, 2020).

One of the classes XI, the materials covered in even-semester terms is buffer. The buffer solution material contains the dimensions of conceptual, factual, and procedural knowledge (Dinata & Zainul, 2020). In this learning material, students are required to go through a series of scientific processes such as observing, formulating problems make observations, make hypotheses, conduct experiments, and draw conclusions (Fadiawati et al., 2022).

The problem that often arises in the field in the way teachers teach using tradisional (conventional) methods and presenting material according to what is in the textbooks. In addition, the teacher has not used a learning model that supports the material and has never held a practicum for the material that must be practiced. Such situations result in students not being trained to develop their analytical power and apply the concepts they have learned in real life that students see and experience, so that student critical abilities are less able to develop properly (Antara, 2022).

Problem solving ability is one of the most important skills in science learning. This ability can train students in solving chemical problems by paying attention to the process of finding answers. So that in learning chemistry problem solving ability has an important role in achieving maximum education outcomes (Ningrum et al., 2020).

A learning model is used to expand high students' innovative abilities and current competencies, specifically in actual everyday life styles and the ability to remedy problems then make scientific responsible conclusions (Mulyana et al., 2018). The learning model needed at this time is a learning model that creates student creativy and can contain tudents within the gaining knowledge of process. One of them is a problem based wherein gaining knowledge is presented with actual problems and clear up collectively in order that it races on students. Problem-based learning is a mastering version that teaches students to instill wondering talent, problem fixing competencies and trains high students independence. Problem based learning is a modern getting to know model that can make scholar getting to know situations energetic so as to improve student mastering consequences (Hasanah et al., 2021).

In addition to the learning model, one of the coaching materials that can be used to help the gaining knowledge of technique is a module. Teaching substances can enhance chemistry coaching and learning sports so that it will make college students study chemistry more effortlessly, efficaciously, and self focused so that there's a shift trainer focused learning to pupil targeted getting to know (Simangunsong & Pane,

2021). Teaching materials inside the shape of modules may be blended with interactive multimedia teaching subtances in e-module layout. e-Modules are coaching subtances within the shape of modules supplied in digital shape to growth students' interest and motivation in getting to know. In principle, the difference between a module and an digital module (e-module) is most effective observed in the shape of the physical presentation and there is no distinction in the components that make up the the module (A. D. Siregar & Harahap, 2020). e-Modules as teaching materials have characteristics including : self instructional, self contained, stand by myself, adaptif, person friendly using constant fonts, spacing and layout introduced via computer based electronic media, using various features of electronic media, utilizing various software of choice of application and designed with learning principles in mind (Asmiyunda et al., 2018).

Purely on observations from SMA Negeri 2 Kabanjahe, information was obtained that students felt that chemistry was a difficult subject because the concept was difficult to understand, the methods used in learning activities were only fixated o textbooks and in the lecture style, in mastering students were never invited to solve problems. A problem in class discussion forums that can stimulate the emergence of new ideas from the results of thinking with students. Low student's education outcomes and interest were also caused by the net learning manner at some point of the Covid-19 period using whatsapp groups with student worksheet media. This makes students feel bored and reluctant to attend class and results in low education outcomes and interest in learning and not yet accomplishing the minimum completeness standards. So that an attempt is needed to improve scholar getting know results, certainly one of that is by means of applying a problem-based learning model in chemistry learning.

As stated previously, this article describes the application of a problem-based learning model assisted by e-modules to the education outcomes and interests of class XI students in the buffer solution material.

▪ METHOD

The population of consisted only of students in class XI at SMAN 2 Kabanjahe in even semesters majoring in science for the 2022/2023 school year with the 2013 curriculum on buffer solution teaching materials. Samples had been taken the use of purposive sampling approach. The sample in this have a look at become class XI MIPA 3 as an examination class where problem-based learning model assisted by e-modules is implemented. Futhermore, another class ei.ge - XI MIPA 4 serve as a baseline class where the method used is direct instruction model assisted via e-modules.

In this study, there are two types of conduct toward examination class and baseline class. The examination class was instructed with problem-based learning model and the learning media is e-modules, whilst baseline class is taught with the direct instruction learning model. The research design used is a real experiment. Student's education outcomes and the excecution of the treatment were obtained by using tests on students. The tests given to students consist of a pretest inside the form of a multiple choice look at 20 items with five answer choiches and a student interest questionnaire consisting of 30 statements and the analysis used was quantitative analysis. The results are processed using the following calculations:

$$\text{Value} = \frac{\text{Score}}{\text{Total score}} \text{ x100}$$

Data analysis techniques in this study include N-gain test, normality test, and hypothesis testing. The hypothesis was tested with a two-sided t test and the correlation between interest and education outcomes was tested with product moment.

▪ RESULT AND DISCUSSION

Data Analysis of Education Outcomes and Interest in Learning
Data on Student's Education Outcomes

Using calculation derived from the tabulated result of each training, the pretest and posttest averages in the examination class and standard class were obtained as shown in Figure 1.

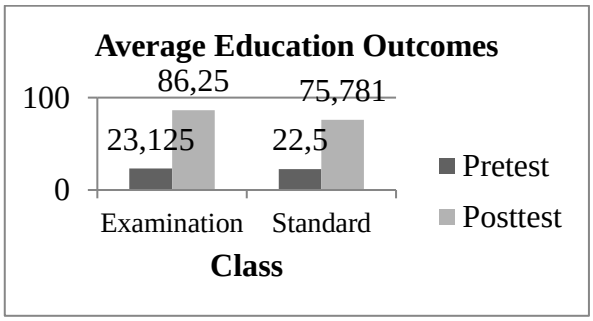

Figure 1. Graph of Average Student's Education Outcomes

Student Learning Interest Data

Based totally at the effects of calculations from tabulated data on check outcomes in both instructions, the average value of interest earlier than and after in the examination class and standard class is display in Figure 2.

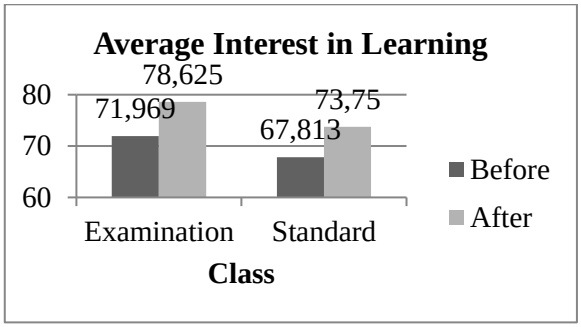

Figure 2. Graph of Average Student Learning Interest

N-gain Test

The average N-gain education outturn and student learning interest are obtained which are presented in Table 1 below.

Table 1. N-gain Average of Student Education Outcomes and Interest

Class	Data	N-gain	Criteria	Description
Examination	Education Outcomes	0,820	(g) ≥ 0,7 High	High
	Interest to Learn	0,207	0,3 ≤ (g) < 0,7	Low
Standard	Education Outcomes	0,687	Moderate	Medium
	Interest to Learn	0,184	(g) < 0,3 Low	Low

Primarily based on the facts whitin the Table 1 above, the increase in student's education outcomes in the examination class turned into 82% higher than the education outcomes within the standard class, 68,7%. So the difference in student's education outcomes of 13,3% in both classes. Meanwhile, the learning interest of students within the examination class became 20,7% higher than the learning interest of students within the standard class 18,4%, so that the difference in students studying interest becomes 2,3%.

Normality Test

Education Outcomes

The information normality check was accomplished by way of the chi square test at a significant level $\alpha = 0,05$ with the standards if $X^2_{count} < X^2_{table}$ then the data is said to be normal distribution, the records obtained may be visible in Table 2.

Table 2. Normality of Education Outcomes

Class	Data	X^2_{count}	X^2_{table}	α	Description
Experiment	Pretest	4,389	11,0705	0,05	Normal
	Posttest	7,509	11,0705	0,05	Normal
Control	Pretest	3,452	11,0705	0,05	Normal
	Posttest	9,960	11,0705	0,05	Normal

From the data in Table 2 above, it could be concluded that the X^2_{count} inside the pretest and posttest facts for the examination class and the standard class is smaller than X^2_{table} so the data is refered to as typically normally distributed.

Learning Interest

The data normality test become carried out with the aid of the chi square test at a significant level $\alpha = 0,05$ with the standards if $X^2_{count} < X^2_{tabble}$ then the data is called relatively normal. Table 3 contains the information that was dicovered.

Table 3. Learning Interest Normality Test

Class	Data	X^2_{count}	X^2_{table}	α	Description
Examination	Before	10,018	11,0705	0,05	Normal
	After	5,222	11,0705	0,05	Normal
Standard	Before	10,422	11,0705	0,05	Normal
	After	8,923	11,0705	0,05	Normal

From the data in Table 3 above, it can be concluded that X^2_{count} on interest data before and after in examination class and standard class is smaller than X^2_{table} so that the data is called normal distribution data.

Homogeneity Test

Homogeneity analysis was carried out with criterion that if $F_{count} < F_{table}$ with a significant level of $\alpha = 0,05$, then the data is called homogeneous. Data on the homogeneity of student's education outcomes and interests are presented in Tables 4 and 5.

Table 4. Homogeneity Test of Learning Outcomes

Class	Data	F_{count}	F_{table}	Description
Examination	Pretest	0,990	1,822	Homogeneous
Standard				
Examination	Posttest	0,785		Homogeneous
Standard				

From the data in Table 4 above, homogeneity test of student education outcomes obtained $F_{count} < F_{table}$ then Ho is accepted or the data is normally because there is no difference within the variance of the data in the examination and standard class.

Table 5. Learning Interest Homogeneity Test

Class	Data	F_{count}	F_{table}	Description
Examination	Before	0,756	1,822	Homogeneous
Standard				
Examination	After	1.013		Homogeneous
Standard				

From the information in Table 5 above, homogeneity test of college students interest in learning obtained $F_{count} < F_{table}$ so Ho is accepted or the data is normally because there's no difference inside the data variance in the examination and standard class.

Hypothesis Test

Hypothesis Test I

The data analysis concluded that the posttest data gathering from the two classes are normally alloted and homogeneous. The hypothesis will be tested using the righ handed t statistical test with the criteria $t_{count} > t_{table}$ so that Ho is rejected but Ha is accepted. Table 6 presented the finding of the first hypothesis test.

Table 6. Results of Education Outcomes Hypothesis Test

Class	$\bar{X}$	S^2	T_{count}	t_{table}	Description
Examniation	86,250	24,194	9,415	1,697	Ha is accepted and
Standard	75,781	30,822			Ho rejected

From the data in table above, it can be concluded that t_{count} for learning outcomes is 9,415 > t_{table} (1,689) so that Ha is accepted and Ho rejected.

Hypothesis Test II

The student's interest data was tested the righ handed t statistical test with the criteria $t_{count} > t_{table}$ for Ha is accepted and Ho is rejected. Table 7 convey the findings of the second hypothesis test.

Table 7. Learning Interest Hypothesis Test Results

Class	$\bar{X}$	S^2	T_{count}	t_{table}	Description
Examination	78,625	42,887	2,987	1,697	Ha is accepted and
Standard	73,750	42,323			Ho rejected

From the information above, it can be concluded that t_{count} for interest in learning is 2,987 > t_{table} (1,697) so that Ha is accepted and Ho is rejected.

Hypothesis Test III

The correlation tests is determine the relationship between outcomes and interest in learning with the $r_{count} > r_{table}$ test criteria to determine whether or not the hypothesis is accepted. Correlation test result exhibited in Table 8 below.

Table 8. Correlation Test Results of Education Outcomes and Learning Interest

Data	N	r_{count}	r_{table}	CD	Description
Student's Education Outcomes and Interests	32	0,731	0,349	53,44%	Ha is accepted and Ho is rejected

From the table above, we can concluded that there is a positive correlation between the outcomes and interest in learning because the results of $r_{count} > r_{table}$ (0,731 > 0,349) with a coefficient of determination of 53,44%.

Discussion

This research was conducted at SMA Negeri 2 Kabanjahe in class XI. This research was conducted in a face-to-face situation. Sampling in this study using purposive sampling technique. The sample used was two classes, namely class XI IA 3 as an examination class taugh with a problem-based learning model assisted by e-module and XI IA 4 as the standard class taught with the direct instruction assisted by e-module. Before starting learning researchers will start with prayer and attendance activities students to know the presence of students in following the process learning. Then both classes will be taught with different learning models. The researcher gave an initial test to determine the initial ability of students regarding buffer solution material and distributed a learning interest questionnaire to determine students' initial interest in learning.

The next step is to apply the problem-based learning model assisted by e-module in the examination class and direct instruction model assisted by e-module in the standard class. The learning process in the examination class began with the researcher explaining the learning objectives and motivating students to be actively involved in solving problems when the learning process took place and forming students into five groups. Furthermore, researchers provide material about buffer solutions using e-modules that are distributed to students via whatsapp, researchers gave assignments to each group to cooperate in collect data and solve problems given by researchers. At the end of the lesson the researcher evaluated and told each group to present the result they are working on, then the researcher appoints students to conclude the work of each group of learners.

Whereas in the standard class, the learning process began with the researcher explains the learning objectives and motivates students to be actively involved in solving problems when the learning process takes place and students only listened to the explaination from the researcher about the buffer solution material contained in the e-module and noted the important points of each lesson. After that, the researcher gave questions that were done by each student, then at the end of the lesson the researcher concluded learning material.

After three meetings of learning were through and data from the examination class and standard class had been analyzed, the average value of education outcomes in the examination class taught with the problem-based learning model assisted by e-module was 86,250 with an interest afterwards of 78,625. Whereas in the standard class, the learning used the direct instruction model assisted by e-modules, the average education outcomes were 75,781 and the interest afterward was 73,750.

In the N-gain test, the improvement of education outcomes in the examination class is relatively high, and for increasing learning interest it is still relatively low. Whereas in the standard class the increase in education outcomes was classified as medium additionally, the rise in interest was minim. Therefore, based on the research conducted, we might therefore say that the cause of the low interest in learning in two classes is that the e-modules used do not display pictrures or provide examples of the material being explained so that students still feel confused. In the examination class, students feel constrained in learning that is bound and full of demands so that the impact of increasing interest is not too big. Whereas in the standard class the increase in learning interest was still relatively low because the chemistry subject started at the last hour of school so that students experienced boredom while participating in the chemistry learning process.

Based totally on the consequence of the right-side t test in the first hypothesis test, it is known that $t_{count} > t_{table}$, it can be concluded that the education outcomes of students who are taught with the e-module assisted problem based learning model are higher than the students who are taught with the e-module assisted direct instruction learning model. This is supported by previous researchers (W. D. Siregar & Simatupang, 2020) who said that the mastering outcomes of students who had been taught the use a problem-based learning model had been better than the education outcomes of students who had been taught the use of the direct instruction model. According to (Supriyono, 2018) using media in the learning process can arouse student interest. According (Nursyam, 2019) learning by using information technology-based media can increase students' interest in learning. According (Susrini, 2021) e-module media and interest in learning together influence education outcomes.

Based on the t-test's findings on the two hypothesis on the righ side, it is known that $t_{count} > t_{table}$. From the results obtained, it can be seen that there is a change, namely before learning begins (before being given treatment) and after learning is complete (after being given treatment). To concluded that the learning interest of students who were taught in the examination class using the problem based learning model supported by e-module was higher than the learning interest of students who were taught in the standard class uses a e-module with a direct instruction learning model. This is supported by previous (Kiabeni et al., 2021) gaining kowledge models have a high-quality effect on student interest and studying result and according to (Supriyono, 2018) the use of learning media can arouse student interest.

Judging by the outcomes of the correlation test the use of the product moment inside the third hypothesis, it is known that $r_{count} > r_{table}$ so that Ha is widely wide-spread, this means that there is a relationship between the two variables and Ho rejected. Inside the N=32 study, t_{count} 0,371 > t_{table} 0,349 and the coefficient of determination (CD) was 53,44%. So it may be concluded that there is a positive parallel relationship among education outcomes and interest in problem based learning models assisted by e-modules on buffer solution material in class XI MIPA. This is supported by previous researcher , namely according to (Wiradarma et al., 2021) saying that student' interest in

learning is positively and significantly related to their education outcomes and according to (Islamiah, 2019) interest in learning is proven to improvelearning outcomes.

▪ CONCLUSION

According to the assessment of the scientific evidence, it can be said that : (1) education outcomes taught with the e-module assisted problem-based learning model are higher than usage of the e-module assites direct instruction model. (2) The interest in learning taught using the e-module assisted problem-based learning models is higher than the studying interest of students taught using the e-module assistes direct instruction version. (3) There is a significant correlation between the outcomes and students' interest with the problem based learning version assisted by e-modules.

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