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The Effect of Using *E-module* Isolation and Characterization Bacteria for Biology Enrichment Program to Improve Cognitive Learning Outcomes

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Abstract. This study aims to know the effect of using *Electronic Module* (E-module) for biology enrichment program to improve the cognitive learning outcomes for students in Senior High School at 10th grade. This research used quasi experiment method which were a control group and also an experiment group. The populations consist of 26 students of Senior High School at 10th grade as a control group and 28 students of Senior High School at 10th grade as an experiment group (using e-module).The research results of cognitive learning outcomes in both of groups were obtained based on pretest and posttest data. These data were analyzed using by *paired t test* and *N-gain score* to know the difference effect of using enrichment e-module in experiment group that was compared to control group. The result of *paired t test* shows that the use of e-module isolation and characterization bacteria for biology enrichment program have a significant effect to student's cognitive learning outcomes on 0.05 level (*two-tailed*). Except that, based on analysis of *N-gain score*, indicated the categorized of student's achievement on cognitif learning outcomes. The average score of n-gain score in the experimental group is 0.74 which means that the achievement's categorized of students' cognitive learning outcomes after using the e-module enrichment is high, while in the control group (without using enrichment e-module), the average n-gain score is 0.41 that indicates the achievement of cognitive learning outcomes in control group is quite moderate. Thus, it can be concluded that the use of isolation and characterization of bacterial improving students' cognitive learning outcomes.

KEYWORDS: *E-Module, Enrichment, Isolation, Characterization, Bacteria, Cognitive Learning Outcomes*

INTRODUCTION

The globalization era offers various of convenience in accessing human needs, including communication. Information and communication flow very quickly as a positive impact of the progress of Science and Technology. This also contributes to the education side. One of them relates to the emergence of new technology in learning that is mobile learning.

Mobile learning is a learning technology that utilizes mobile devices such as PDAs, smartphones, tablet PCs, computers and others as means to transfer learning materials. Clark Quinn defines the concept of mobile learning or also called e-learning as follows: *"The intersection of mobile computing and e-learning : accessible resources wherever you are, strong search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment. Mobile learning independent of location in time or space"*[1].

The use of mobile learning makes it easy for anyone to access learning materials whenever and wherever they are or in other words mobile learning has a concept as a distance learning (without having face to face in a room). Mobile learning has an interesting visualization, so it is suitable that is used as media and learning materials to help students to understand and to enrich learning materials. Mobile learning as a learning resource is presented in several forms such as electronic module (E-module), interactive learning video, and others.

E-module has the same characteristics as a print module which must contain of five things, such us: self-instructional, self-contained, stand-alone, adaptive and user friendly [2]. E-module is used in structured and independented learning can stimulate students to explore learning materials. This will certainly affect their speed in absorbing learning materials independently.

The main objective that will be achieved by educators for the students after providing the learning experience is the improvement of learning outcomes. Learning outcomes are the abilities of the student which have after learning experience. Learning outcomes are not just about knowledge, but also attitude and behavior. This is based on the opinion that the learning outcomes are patterns of actions, values, knowledges, attitudes, appreciations, abilities, and skills[3] as well as changes that occur in students and also that involve in cognitive, affective, and psychomotor aspects as the result of learning[4].

The cognitive learning outcome or ability in a person is divided into 3 domains, namely cognitive, affective and psychomotor. The learning outcomes of the cognitive domain are oriented towards thinking ability, including the simple abilities till the ability to solve a problem. The measurements of cognitive learning outcomes by Anderson and Krathwohl include: remember (C1), understand (C2), apply (C3), analyze (C4), evaluate (C5) and create (C6)[5]. Electronic module (*E-module*) can be an excellent solution to transfer self-learning materials for students. Thus, students can enrich their learning experience by using e-module. This principle is in line with the learning objectives of the enrichment program which aims to strengthen the competency aspect that has been mastered by learners[6].

The material presented in this enrichment program is an enrichment material of classical learning materials that has been structured in the educational curriculum in Indonesia. One example of enrichment material in biology side is isolation and bacterial characterization.

Isolation and Characterization Bacteria's material packed in e-module will attract students interest to learn it, thus expected the use of e-module isolation and bacterial characterization can also improve students' cognitive learning outcomes.

METHOD

This study uses quasi experimental method with the design of Nonequivalent Control Group Pretest Posttest Design as shown in Table 1 below.

TABLE 1. *Nonequivalent Control Group Pretest Posttest Design*

Pretest	Treathment	Postest
O_1	-	O_2
O_3	X_1	O_4

Information:

O_1 = pretest control group
O_2 = posttest control group
O_3 = pretest experimental group
O_4 = posttest experimental group
X_1 = enrichment program by using E- module

The sample used in this study was obtained based on random sampling technique which consists of two groups, one group as control group (without using E-module but through peer tutor teaching in answering questions in the matter) and other group as an experiment group (with using E- module). Both of groups were students of class X MIPA in SMA N 1 Jetis Bantul. In the control group, the sample used 26 students while the sample of the students used as the experimental group was 28 students with similar initial ability level.

Pretest and posttest data obtained in the control and experiment group were analyzed using SPSS 16.0 program by using paired sample t test to know the improvement of cognitive learning outcomes before learning (pretest) with after learning (posttest) in each group (control and xperimental group). Except that, data were analyzed by *N-gain score* to to know the level of improvement of students' cognitive learning outcomes among control group and experimental group.

N-gain score was obtained through the formula below:

$$g = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}$$

Table 2 shows the conversion of the Normalized Gain Score *(N-gain score)* at the cognitive learning outcome level[7] :

TABLE 2. *Conversion of N-Gain Score to Cognitive Learning Outcome Level*

Normalized Gain Score	*Level*
g > 0,70	High
0,70 > g > 0,30	Medum
0,30 > g	Low

RESULT AND DISCUSSION

Data Normality Test In Control and Experiment Group

The data normality test is performed to know that the sample data comes from a normally distributed population. The normality test uses SPSS that is based on Kolmogorov-smirnov[a] test with significance level α = 0.05. Tables 3 and 4 show the results of normality test data in the control and experiment group.

TABLE 3. The results of normality test data in the control group

Tests of Normality				
	Control_Data	Kolmogorov-smirnov[a]		
		Statistic	df	Sig.
Cognitive_learning_outcome	pretest	.163	29	.074
	posttest	.091	29	.200

Based on Table 3 above, it is known that the value of significance (p) is 0.074 and 0.200. Thus, p > α, so it means that the sample comes from a normally distributed population.

TABLE 4. The results of normality test data in the experimental group

Tests of Normality				
	Experimental_Data	Kolmogorov-smirnov[a]		
		Statistic	df	Sig.
Cognitive_learning_outcome	pretest	.154	28	.087
	posttest	.161	28	.062

Table 4 above explains that from normality test results, it is known that the value of significance (p) is 0.087 and 0.062. Thus, p > α, then the sample comes from a normally distributed population.

Data Homogeneity Test In Control and Experiment Group

The homogeneity test was conducted to find out whether two or more groups of sample data came from populations having the same variance (homogeneous). The significance level used α = 0.05. Therefore, if the significance of α was obtained, then the variance of each sample was the same (homogeneous), but if the

significance obtained <a, then the variance of each sample was not equal (not homogeneous). Tables 5 and 6 showed homogeneity test results in the control and experiment groups.

TABLE 5. . Homogeneity Test Results In Control Groups

Test of Homogeneity of Variances

Cognitive_learning_outcome

Levene Statistic	df1	df2	Sig.
.220	1	56	.641

Based on Table 5, it is known that the significance value of 0.641. Thus, the significance of > α, then the cognitive learning outcome data in the control group is homogeneous.

TABLE 6. Homogeneity Test Results In Experiment Groups

Test of Homogeneity of Variances

Cognitive_learning_outcome

Levene Statistic	df1	df2	Sig.
1.889	1	54	.693

In Table 6, the significance of homogeneity test results was 0.693. This means the significance of > α. Thus, the data of cognitive learning outcomes in the experiment group is homogeneous.

Because of the result of prerequisite test (normality and homogeneity test) on both of data types (control and experiment group) are fulfilled the parametric analysis can be done that is paired sample t test with the ratio of α = 0.05. The t test results in the control and experiment groups are presented in Tables 7 and 8.

TABLE 7. Paired sample t test results In Control Group

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Control_Data - Cognitive_learning_outcome	-45.138	18.287	2.401	-49.946	-40.330	-18.798	57	.000

Based on Table 7 it is known that P-value or significance of paired sample t test results is 0.000. Thus, the significance value of 0.00 <0.05, so it can be concluded that in the control group, there are significant (the real differences) between the results of students' cognitive learning when posttest with student cognitive learning outcomes when pretest.

TABLE 8. Paired sample t test results In Experiment Group

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Experimental_Data - Cognitive_learning_outcome	-55.875	26.865	3.590	-63.069	-48.681	-15.564	55	.000

Table 8 shows that the P-value or significance of the paired sample t test results is 0.000. Thus, the significance value of 0.00 < 0.05, so it can be concluded that in the experiment group, there are significant (the real differences)

between the results of students' cognitive learning when posttest with student cognitive learning outcomes when pretest.

Students Cognitive Learning Outcomes's Improvement In Control and Experimental Groups

The improvement of students' cognitive learning outcomes can be obtained through *Normalized Gain Score* analysis (N-*gain score*) presented in Tables 9 and 10.

TABLE 9. *Normalized Gain Score* of Student Learning Outcomes's Improvement In Control Group

Score	*Pretest*	*Posttest*
Minimum score	6	38
Maximum score	52	83
Average	33,38	61,69
Gain Score	0,41	
Criteria of Gain Score	Moderate	

TABLE 10. *Normalized Gain Score* of Student Learning Outcomes's Improvement In Experimental Group

Score	*Pretest*	*Posttest*
Minimum score	18	68
Maximum score	52	100
Average	33,36	82,89
Gain Score	0,74	
Criteria of Gain Score	High	

The improvement of cognitive learning outcomes of students is known from the pretest and posttest scores by using 10 items of multiple choice and 2 items of essays. All of students' cognitive learning outcomes are known from the *Normalized Gain Score* (*N-Gain Score*). *N-Gain Score* shows the categories of improvement or achievement of student cognitive learning outcomes. Based on tables 9 and 10, the *N-gain score* of the control group was 0.41 while the *N-gain score* experiment group was 0.74. When it converted based on table of criteria of improvement of cognitive learning outcomes, the *N-gain score* in the control group is included in the moderate category means that the increase of cognitive learning outcomes in the control group is the moderate, while the *N-gain score* in the experiment group is included in the high category, it means that the improvement of cognitive learning outcomes in control groups is high.

Based on the analysis of research data, the improvement of cognitive learning outcomes in biological enrichment program of isolation material and bacterial characterization on students is obtained from the posttest result after it being treated by self-study by using e-module of isolation and bacterial characterization in experiment group and self-enrichment learning (by doing a number of problems) in the control group. The differences of learning outcomes in both of groups resulted a difference in posttest results that seen in the Figure 1:

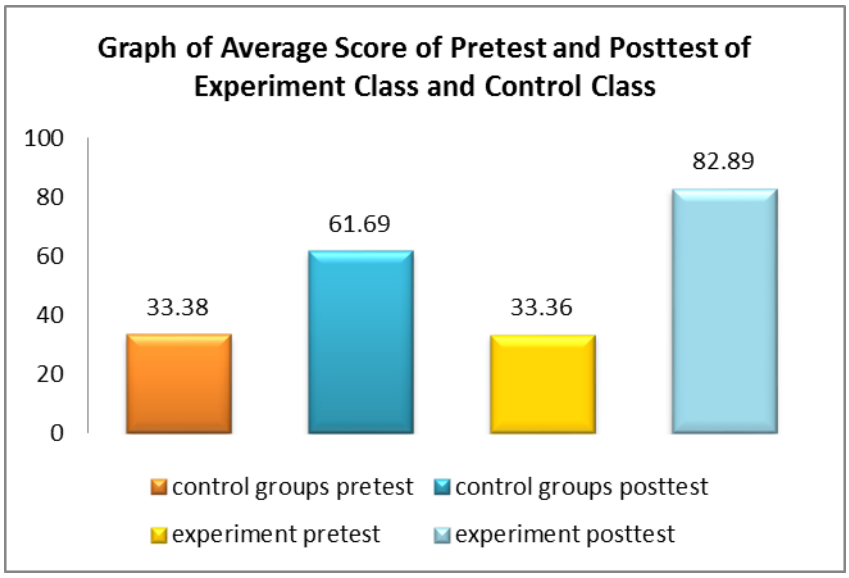

FIGURE 1. Graph of Average Score of Pretest and Posttest of Experiment and Control Class

The graph above shows that self-enrichment learning treatments by use e-module enrichment isolation and bacterial characterization in the experiment group gives the average is higher post-test score than the control group (without using e-modules). This matter shows that self-enrichment learning by using e-modules has a greater impact than ordinary self-enrichment learning. Not only that, based on the normalized gain score obtained by both of groups, the level of cognitive learning outcomes of the students in the experiment group was higher than that of the control group which was only moderate. So that, it can be concluded that the use of e-module in the enrichment program proved able to improve students' cognitive learning outcomes. This is because of e-modules attract students to learn.

E-Module is able to attract students to learn because the e-module has many pictures, videos or examples so students more interested to learn it and more quickly understand learning materials. This is similar to Purnomo's opinion that said if examples in the module can generate student interest in studying the module, the interested attitude is a good capital for students in studying the contents of the module[8].

In addition to contain these components, E-module isolation and characterization bacterial also use a communicative language so that makes students easy to understand the material contained in the e-module. According Widyaningrum, module which created with using communicative language and accompanied by examples (pictures) make students easy to understand, and the pictures contained in the module can be support and clarify the content of the material thereby generating attraction and reduce boredom for students[9].

The improvement of cognitive learning outcomes after using e-modules also matches the results of research conducted by the IRIS Research Center in the United States and Europe in 2014 that the use of online modules in learning can improve students' knowledge, application abilities, and confidence. Student learning outcomes by using online module or e-module were significantly higher in the conceptual application of knowledge measure than students who participated in regular learning[10].

Successful of using e-modules in learning such as enrichment programs for isolation and characterization of bacteria is inseparable from several supporting factors, such as electronic devices that support e-module application programs, the ease in operating e- modules, teacher and student skills in running applications is as well as clarity of guidance provided teachers to students.

CONCLUSION

Based on the objectives and discussion of research results, it can be concluded that the using of e-module isolation and characterization bacteria in biology enrichment program improves the cognitive learning outcomes of high school students. This is indicated by the value of significance ($p < 0.05$) and high score of average of *N-gain score* in the experiment group is compared with the average score of *N-gain score* in control group. The average

score of *N-gain score* in the experiment group is 0.74 which means that the achievement's level of students' cognitive learning outcomes after using the e-module enrichment is high, while in the control group (without using enrichment e-module), the average *N-gain score* of 0.41 indicating that the achievement of cognitive learning outcomes in control group is quite moderate level.

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