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The Effectiveness of Enrichment E-Module of Karangsong Mangrove Ecosystem to Improve Students Scientific Literacy

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***Abstract*—Karangsong mangrove forest is a potential ecosystem to be used as learning resource for ecosystem material. However, this ecosystem has not been used optimally for learning, and students' scientific literacy in Indonesia is categorized low. The aim of this study is to determine the effectiveness of enrichment e-module of Karangsong mangrove ecosystem to improve students' scientific literacy. This research is a development research with ADDIE research model (Analysis, Design, Development, Implementation, and Evaluation). This study was conducted at SMAN 1 Sindang in the science class of tenth grade (XI MIPA). The subjects were 42 students selected using purposive sampling method. The instrument used in this study was a test of scientific literacy. The results revealed that the students' average scientific literacy in the experimental class was higher than in the control class, seen from the Mann Whitney test with a significance value 0.024 < 0.05, and the N-gain score in the experimental class was higher than in the control class which is 0.51 > 0.36. These results indicated that enrichment e-module of the Karangsong mangrove ecosystem is effective to improve students' scientific literacy.**

Keywords: ecosystem, e-module, enrichment, mangrove, scientific literacy

I. INTRODUCTION

Indramayu regency is an area adjacent to the north coast of Java island, and the potential nature in this region are beaches and mangrove forests. Data from Forestry Service of West Java (2016) showed that the area of mangrove forests in Indramayu reached 12.706,19 Ha [1]. The natural wealth of mangrove forests should be an alternative potential learning source which is potential for students in the nearest area. One of potential local in Indramayu that can be explored as learning source is Karangsong mangrove forest. This area was just inaugurated as Pertamina Learning Center of Biodiversity and Mangrove Arboretum in December 10, 2016 by the Minister of Environment and Forestry, and it is said that Karangsong mangrove forest us a learning based on local potential. However, the reality in the field showed that ecotourism is not fully utilized as a learning source for students [2].

Learning source choices is able to determine students' learning achievement. The students who succeed in learning will surpass the minimum criteria of mastery and will get enrichment. The observation result at SMAN 1 Sindang revealed that the Karangsong mangrove forest is not studied yet in depth as a learning source for ecosystem material and the students who completed their learning has not been given an enrichment learning. One of alternative solutions that can be chosen is to make the Karangsong mangrove forest as a learning source enrichment for students.

Learning about the Karangsong mangrove ecosystem requires a considerable amount of time if studied and observed directly by students. Module is chosen as an effective and efficient alternative teaching material to overcome these limitations. Modules that are integrated with the mangrove ecosystem as local potential can be accessed by students quickly and precisely so that the learning becomes more optimal. The use of modules based on local potential of ecosystem topics is able to improve students' conceptual understanding [3]. The modules collaborated with science learning will give students the opportunity to carry out the scientific investigation, solve problem, and increase the students' science knowledge [4].

The development of teaching material which is a module should be in line with students' need [5]. One of technologies which is close to students' daily life is smartphone or Android. The students stated that they rely more on smartphone, and more than 80% of students use smartphone to assist them in learning [6]. Learning using smartphone is able to add and support existing knowledge, discover new knowledge, apply knowledge, and share knowledge, so that the students are more interested to study using smartphone [7]. Based on these explanations, the development of modules that are integrated to the local potential of Karangsong mangroves and can be accessed through smartphone might be suitable with the students' characteristics and needs.

Module packed in electronic form is called e-module. E-module can be accessed through student's smartphone because of its effectiveness and efficiency to use in learning. More importantly, the use of smartphone in completing the school assignment can improve the student's achievement in the field of science [8]. In this case, the teachers are recommended to help develop the smartphone's use in teaching and learning [9]. The teacher's involvement in integrating the learning using smartphones is very beneficial for learning development [10]. Besides, e-module can attract students' interest and improve students' thinking skill [11]. This is because e-module is able to present the material phenomena and its processes that cannot be observed directly because they have a high degree of flexibility and portability [12]. E-module also represents movements, has

an application, and has extensive layout [13]. Thus, the integration of local potential of the Karangsong mangrove ecosystem in the form of an e-module application is expected to be able to increase students' interest and thinking skill.

One of the important thinking skills for students is scientific literacy [14]. The scientific literacy of Indonesian students are still relatively low. The low level of scientific literacy has been a concern throughout the world, and the importance of the discussion on scientific literacy begins to diminish [15]. Based on PISA 2015, Indonesia is in the lowest 10 group compared to other countries [16]. It then becomes one of the homeworks for academician. Creating enrichment e-module of the Karangsong mangrove ecosystem is one of the ways to overcome. This learning might improve students' scientific literacy [17].

Based on the background above, the researchers developed enrichment e-module of the Karangsong mangrove ecosystem in order to improve students' scientific literacy.

II. RESEARCH METHODOLOGY

This study is R&D (Research and Development) with ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) [18]. This study was conducted at State Senior High School 1 Sindang. The research subjects were 42 science students of tenth grade selected through purposive sampling and divided into experimental class and control class. The samples were chosen based on the achievement criteria of the KKM value which is 75. The research design used in the field trial is a non equivalent control group design. The students are placed in the experimental and control class randomly [19]. Then, scientific literacy was measured through an essay test that was made based on indicators of scientific literacy. A pre-test was conducted in the experimental and control class before learning. A treatment in the experimental class used enrichment e-module of the Karangsong mangrove ecosystem while in the control class used conventional learning. After enrichment learning, the students were given a post-test.

TABLE I. EXPERIMENTAL DESIGN

Class	Pre-test	Treatment	Post-test
Experiment	O1	X[a]	O2
Control	O1	Y[b]	O2

[a.] X using enrichment e-module
[b.] Y using conventional learning

III. RESULTS AND DISCUSSION

A. Results

The results of pre-test and post-test in descriptive statistics can be seen in Table I. The data in Table II showed that the average value of the pre-test in the experimental class is not much different from the pre-test in the control class, which are 47.10 and 48.27. It showed that the two classes have almost the same scientific literacy, so that the experimental class and the control class can be used as comparison class in the study. The difference of scientific literacy between the experimental class and control class can be seen from the test of inferential statistics. Thus, it is necessary to do normality and homogeneity tests as a prerequisite test to conduct inferential statistics. The result of normality test is seen in Table III.

TABLE II. DESCRIPTIVE STATISTICS OF SCIENTIFIC LITERACY

	Experimental class		**Control class**	
	Pre-test	***Post-test***	***Pre-test***	***Post-test***
Sample	20	20	22	22
Max Value	58	94	62	80
Min Value	30	58	38	50
Average	47.10	73.60	48.27	66.82

TABLE III. NORMALITY TEST RESULTS OF SCIENTIFIC LITERACY

Class		**Kolmogorov-Simrnov (Sig.)**	**Category**
Pretest	Experiment	0.003	Abnormal
	Control	0.200	Normal
Posttest	Experiment	0.200	Normal
	Control	0.194	Normal

Significance value (2-tailed) of the pre-test in the control class, post-test in the control class and post-test in the experimental class is greater than 0.005 ($p > 0.05$), and it means that the data were normally distributed, while the significance value (2-tailed) of the pre-test in the experimental class is 0.003 which is smaller than 0.05 ($p < 0.05$), so the data was not normally distributed. Furthermore, the result of homogeneity test can be seen in Table IV.

TABLE IV. HOMOGENITY TEST OF SCIENTIFIC LITERACY

		Sig.	**Category**
Post-test	Based on mean	0.649	Homogeneous
	Based on median	0.660	
	Based on median and with adjusted df	0.660	
	Based on trimmed mean	0.617	

The data in Table IV has a significance value more than 0.05, which is $0.649 > 0.05$ ($p > 0.05$), and it can be concluded that the experimental class and the control class had homogeneous variances. The result data from the prerequisite test demonstrated that the data are homogeneous but not normally distributed, as a result, Mann Whitney test is used to see whether there is any significant difference of students' scientific literacy between the experimental class and the control class. The result of Mann Whitney test can be seen in Table V.

TABLE V. MANN WHITNEY RESULT OF SCIENTIFIC LITERACY

Class	**z**	**Asymp. Sig (2-tailed)**	**Note**
Eksperimen kontrol	-2.254	0.024	There is a difference

Data in Table V presented that Asymp. Sig value (2-tailed) is less than 0.05 which is $0.024 < 0.05$. This showed that there is significant difference in students' scientific literacy between the experimental class and the control class. Therefore, that H_0 is rejected and H_a is accepted

indicated that there is an influence on the use of enrichment e-module of Karangsong mangrove ecosystem on students' literacy.

The improvement of students' literacy can be seen from the calculation of normalized gain score (N-gain). The result analysis of N-gain calculation is presented in Table VI.

TABLE VI. CALCULATION OF NORMALIZED GAIN SCORE (N-GAIN)

Score	Gain Score Average	Gain Score Category
Experimental Class	0.51	Moderate
Control Class	0.36	Moderate

The data in Table VI showed that N-gain in the experimental class and control class is in the same category (moderate). However, N-gain score in the experimental class is higher than in the control class, which is 0.51 > 0.36. In other words, the improvement of scientific literacy in the experimental class is higher than in the control class

B. Discussion

Higher scientific literacy in the experimental class indicated that the learning resources used in this study are appropriate and suitable. The appropriate learning resource is able to facilitate students in understanding the material [20]. The enrichment e-module examines the local potential of mangrove forest in Karangsong village. In addition to deepening the ecosystem material, the students who used enrichment e-module also learn about the local potential in their existing area. Learning that utilizes local potential as a learning resource can make it easier for students to achieve learning competencies [21]. One of the competencies trained in this study is scientific literacy. It was proven that the students in the experimental class achieved the competencies of scientific literacy easier than in the control class. It is in line with Lestari's study which suggested that local potential-based learning packaged in module can improve students' scientific literacy [17].

In addition to choosing appropriate learning resources, the modules that are packaged appropriately can also affect the students' ability to learn. One of the efforts to improve students' ability is to package enrichment modules in electronic form (e-module) that can be accessed in Android smartphone. Modules that are packaged electronically are able to motivate and improve students' thinking skills [11]. Further, learning with the use of Android device can be easily utilized and freely available, and the students can access learning material quickly and easily so that the learning becomes effective [22].

One of students' characteristics who is literate in science is able to understand the relationship between science and technology [23]. Students who learn with mobile learning approach are more accomplished and significantly motivated than conventional learning students [24]. This is evidenced by the results of the Mann Whitney test showing that there is any significant difference in scientific literacy in the experimental class and in the control class. Thus, it can be possible that these differences are a result of the enrichment e-module of the Karangsong mangrove ecosystem.

The calculation data of N-gain showed that the experimental class and control class are in the same category (medium), however, the N-gain score in the experimental class is higher than in the control class, which is 0.51 > 0.36. The N-gain score in the control class is closer to low category than in the experimental class. It concluded that the improvement of students' scientific literacy in the experimental class is better than in the control class. These are the results of using enrichment e-module of the Karangsong mangrove ecosystem that is able to enhance students' scientific literacy.

IV. CONCLUSION

The use of enrichment e-module of Karangsong mangrove ecosystem is more effective to improve the students' scientific literacy when compared to the conventional learning. This argument is indicated by the higher average score of scientific literacy in the experimental class than in the control class, obtained from Mann Whitney test with the significance value 0.024 < 0.05 and N-gain value in the experimental class which is higher than in the control class 0.51 > 0.36.

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