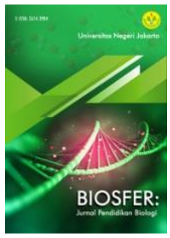
Biosfer: Jurnal Pendidikan Biologi

Journal homepage: http://journal.unj.ac.id/unj/index.php/biosfer



E-module of mangrove ecosystem (emme): development, validation, and effectiveness in improving students' self-regulated

Irma Aprilia*, I Gusti Putu Suryadarma

Biology Education, Faculty of Mathematics and Natural Science, Universitas Negeri Yogyakarta, Indonesia

*Corresponding author: irmaaprilia9495@gmail.com

ARTICLE INFO

Article history
Received: 27 December 2019
Revised: 29 March 2020
Accepted: 14 April 2020

Keywords:
E-module
Ecosystem
Enrichment
Mangrove
Self-regulated learning

ABSTRACT

One of the mangrove forests in Indramayu, West Java, Indonesia that plays an essential role in the environment and becomes a learning center, is the Karangsong mangrove forest. The study aimed to determine the feasibility and effectiveness of Enrichment E-Module of Mangrove Ecosystem (EMME) to improve students' self-regulated learning. This study was Research & Development with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This study was conducted at a Senior High School in Sindang, Indramayu, Indonesia with ten (X) grade of science class. The samples were chosen using a purposive sampling technique, resulting in class X-7 chosen as a control group and class X-8 as an experimental group. The design of this study used a non-equivalent control group design. The average validation result by experts was that media expert of 87.75 (very feasible), material expert of 94.36 (very feasible), and biology teacher of 93.40 (very feasible). The results indicated that the enriched e-module of the mangrove ecosystem was feasible in enrichment learning. E-module did not significantly influence to improve students' self-regulated learning, as seen from the result of the Mann Whitney test (0.077). Improvement of students' self-regulated learning was low, as seen from the N-gain score of the control group (0.06) and the experimental group (0.20). These concluded that the e-module of the mangrove ecosystem could be used in the learning, and short time allocation causes the module not to influence self-regulated learning significantly. Several revisions are needed in order to make the e-module more effective in improving students' self-regulated learning.

Aprilia, I., & Suryadarma, I. G. P. (2020). E-module of mangrove ecosystem (emme): development, validation and effectiveness in improving students' self-regulated. *Biosfer: Jurnal Pendidikan Biologi, 13*(1), 114-129. https://doi.org/10.21009/biosferjpb.v13n1.114-129

INTRODUCTION

In the last 12 years, Indramayu beach in west Java, Indonesia changes more as the cause of climate. It is proven from the intensity of storms, hurricanes, coastal abrasion, and sedimentation (Hadiana & Samosir, 2015). One of the ways that the government does to protect its coastal is through the mangrove forest. Mangrove ecosystem plays a vital role in marine biota, prevents storms, hurricanes, coastal abrasion, and develops a social, economic community (Badola & Hussain, 2005; Hadianti, Azrai & Sukandar, 2014; Karimah, 2017). One of the mangrove areas that conducted massive mangrove restoration is Karangsong, an area in Indramayu regency of West Java, Indonesia. Based on the decision of the regent of Indramayu number; 523.05/Kep.151.A-Diskanla/2014 concerning the establishment of the Karangsong Village Mangrove Center as a mangrove restoration and learning center. However, the role of mangrove as a learning center has not benefited the surrounding community (Fatkhiyani & Suhada, 2018). When visiting Karangsong mangrove ecotourism, recreation becomes the primary purpose for people and students' destinations. The visitation should benefit academicians, particularly educators and students for learning activity. The students have presented a real-life in nature to integrate science knowledge from school and the condition of real life in nature. Science and ecology knowledge have to be connected to evaluate how far the target of science curriculum has been achieved (Windyariani, 2017; Mueller & Tippins, 2010). The connection between science knowledge and ecology knowledge gives benefit to the environment. Students can also implement their knowledge obtained from school to their environment. By learning about mangrove, the students are expected to maintain mangrove stability, which is vital for the community. One of the ways to introduce the importance of mangrove to the community is reviewing mangrove in the learning at school, and one of the materials at school that is suitable for mangrove is ecosystem material. The students are expected to add knowledge about mangrove and its importance to implement it in daily life.

Limited space and time cause mangrove ecosystems unable to be studied directly, so there is a need of medium to accommodate the limitation. One of the solutions to solve the limited space and time is through the mobile learning system (Sun, 2019; Hidayati, Pangestuti & Prayitno, 2019). Educators should explore and experiment with integrating their learning with a mobile application as a need for teaching and learning (Hsu & Ching, 2013). Learning with a mobile application can build a personal learning environment to motivate students to learn (García-Peñalvo & Conde, 2015). Besides, learning with a mobile application is a new method that is suitable for the development of technology in Indonesia nowadays. Technology development has significant impacts on the development of a student's learning style. Technology gives more chances to learn and more opportunities in case of time for other activities (Ristanto, et al., 2020).

Learning activity using a smartphone device gives an important role and better solution compared to the conventional method in the education field (Agustihana & Suparno, 2018; Elkhateeb, Shehab, & El-Bakry, 2019; Furió, Juan, Seguí, & Vivó, 2015; Sarrab, Alzahrani, Alalwa & Alfarraj, 2014). Several factors using conventional methods are limited learning resources, limited time allocation, and less (Maryono, 2016). Moreover, biology is a science of studying objects and natural symptoms (Suratsih, 2010). Its learning resource cannot always be found and observed easily and directly. Some learning resource needs time and difficult observation. The use of smartphones in learning can be an alternative way to represent the object and natural symptoms that the students hardly meet. Based on the analysis of the preliminary study, 73% of students bring a smartphone everywhere. However, only 56% of students often use their smartphones for learning needs. In other words, the use of smartphones for learning needs to be utilized to encourage students to use the smartphone for more useful activity. The students can see offline learning contents through a mobile device, which enables them to learn anytime and anywhere, so learning becomes more efficient (Yau & Hristove, 2017). Mobile learning applications can improve learning (Pechenkina et al., 2017). Besides, mobile learning influences students' achievement (Arain,, Hussain, Rizvi, & Vighio, 2017).

Self-regulated learning skill is essential learning that is carried out throughout life. Self-regulation can also be defined as students' ability to independently and actively motivate themselves to increase achievement or goal (Zimmerman, 2000). Suryabrata (2002) revealed in his research on biology learning that self-regulated becomes one of the essential factors that influence students' successful learning achievement. This is in line with the resulting study from Rijal & Bachtiar (2015) that students' supervised learning influences the result of biology learning with a value of 33.5 %. Puspadita (2018) also elucidated that students' self-regulated learning weigh significantly with their learning achievement on biology.

One of the approaches that can develop students' self-regulated learning is through the technology approach (Bahreman, Chang, Amistad, & Garn, 2016; Nussbaumer et al., 2015). Suitable technology to develop self-regulated learning is mobile learning. Mobile learning can give students motivation, but an appropriate model and suitable strategy to develop self-regulated learning would be needed (Perez-Alvarez, Maldonado-Mahauad, & Perez-Sanagustin, 2018). Learning may take place in very different learning environments: in and out of school, with or without instruction, formally or informally. Mobile learning enables students to learn in a different learning environment. These two situations are distinguished by whether there is a teacher's guidance or not. Students' independence learning develops in learning that is guided without a teacher. In other words, this learning is student-centered learning in which the students can organize their learning styles (Beishuizen & Steffens, 2011).

Nowadays, cellular devices are used in self-regulated learning in several institutions to enhance knowledge to be better (Müller & Faltin, 2011). Mobile learning can create conducive learning for students' environment. Mobile learning can increase self-regulated learning in a group of low self-regulated learning (Shih, Chen, Chang, & Kao, 2016). Self-regulated learning significantly gives impact to support academic achievement (Barnard-brak, Lan, & Paton, 2010; Effeney, Carroll, & Bahr, 2013). The students who have self-regulated learning are more successful in learning than students who do not have self-regulated learning (Dettori & Persico, 2011). Self-regulated learning has a differential effect on developmental stages or students' education level (Panadero, 2017). The students who manage their learning style will be active in searching for information and searching for ways to solve obstacles, and they will have more responsibility (Zimmerman, 1990).

E-module is a tool that can help students increase their self-regulated learning (Jeske, Backhaus & Roßnagel, 2014; Herawati, 2017). Several relevant studies support it, and two of them are a study from Kismiati (2018) and Hapsari (2016). They revealed that enrichment e-module could increase students' self-regulated learning and their learning achievement. Learning using EMME presents exciting features and is designed in an Android-based application so that the students can easily access it from their smartphone. EMME featured with a picture, video, and recommendation link to broaden students' knowledge. The picture is presented contextually depending on the environment's condition, and several representative pictures are presented to provide students' knowledge. Besides, feedback is presented in the last learning activity to measure and to evaluate students' learning achievement. EMME also provides issues in the field so that the students are trained to solve a problem in real life. Besides, the reflection menu is one of the features aimed to measure students' achievement in general. In this menu, the students can write their reflection and send it to the teacher, so it is used as an evaluation to improve EMME to be better.

Technology development enables to develop learning that can be arranged by the students, and they can receive suitable feedback so they can monitor their learning (Hidayati, Pangestuti, & Prayitno, 2019; Bartolome & Steffens, 2011). E-module is designed based on android, so it is expected that the learning becomes useful. Through the e-module, aspects of self-regulated learning can be optimally explored. The students can learn based on their learning speed, so learning becomes more effective and efficient. The students are given the freedom to organize learning activities flexibly, anytime, and anywhere. The students who have lower learning speed can repeat the material at home, so there are no students left behind in learning.

Based on the above explanation, this study is aimed to examine the effectiveness of EMME to increase students' self-regulated learning of a Senior High School in Sindang, Indramayu, Indonesia. EMME gives the students opportunity to regulate their learning activity depending on their learning speed so that the students' self-regulated learning can increase.

METHODS

Research Design

The type of this study is Research & Development with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) (Dick & Carey, 1996). The design of this study used a non-equivalent control group design.

Table 1

Experimental design.

Class	Pretest	Treatment	Posttest
Experiment	O_1	X_a	O_2
Control	O_3	Y_b	O_4

Note:

X_a : Enrichment e-module
Y_b : conventional learning
O_1 : pretest of the experimental group
O_2 : post-test of the experimental group
O_3 : pretest of the control group
O_4 : post-test of the control group

Population and Samples

A Senior High School in Sindang, Indramayu, Indonesia. This study was conducted with the suitable and right procedure. The analysis stage was carried out on August 2018, the design stage was on September until November 2018, development stage was on December 2018 until April 2019, and implementation stage was on April until May 2019. The population of this study was all X grade of Science classes that consist of eight classes. The samples were chosen using a purposive sampling technique with a consideration that the skills from two classes are homogenous in that the two classes can be compared. The chosen samples were X-7 science class as control class consisted of 22 students, and X-8 science as an experimental class consisted of 20 students. The samples were chosen based on the students' abilities and characteristics that were almost the same.

Instrument

The instrument of this study used before implementation was an instrument of preliminary analysis, expert validation, and students' responses. Then, the instrument of self-regulated learning was used to measure the increase in students' self-regulated learning. The instrument of students' self-regulated learning is a questionnaire that was adapted from the instrument of Hapsari's study (2016). This instrument was used to examine the effect of enrichment e-module on the level of students' self-regulated learning before and after enrichment learning. The questionnaire used a Likert scale with four scales, namely Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS). Aspects of students' self-regulated learning are considered in five aspects of self-regulation, namely aspects of self-initiative, self-discipline, self-responsible, self-independent, and self-efficacy. The questionnaire was validated by expert judgments and was corrected based on their advice.

Procedure

EMME was designed through stages of research procedure with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The analysis is a stage to collect information needed for the study. This stage focused on literature review and observation to support the development of the concept study. Competency targeted in EMME is suitable for the 2013 curriculum, namely analyzing information or data from various resources about the ecosystem and the interactions that happened in the ecosystem. The instructional analysis includes the explanation of core and necessary competencies becoming indicators achieved by students. Based on the result of observation in the preliminary study, 80% of students utilized their gadgets to complete the task; however, they had no initiatives to develop their knowledge independently.

Stages of Design consist of designing the framework of EMME through storyboard, designing EMME phases systematically, and designing feedback. Stages of Development consist of collecting references, designing drafts, editing, and a limited trial test. In this stage, editing was conducted through validation experts, namely media experts, material experts, and biology teachers. The limited trial test was conducted for students of XI class who have passed in learning ecosystem material by giving review and assessment on the questionnaire. Feedback and suggestion in the development stage were used to improve EMME and be used in the implementation stage.

Stage of Implementation is a broader scale of trial tests on students who have reached the minimum score. This trial test was conducted in the control class and experimental class, and it includes a pretest, giving treatment, and post-test. In general, the procedure of this study consists of three stages. 1. Pretest by fulfilling the questionnaire of self-regulated learning before the enrichment learning was started. 2. Enrichment learning by referring to the 2013 curriculum. 3. Posttest fulfilling the questionnaire of self-regulated learning after the enrichment learning.

Pretest and post-test were conducted to measure the level of students' self-regulated learning before and after learning. It resulted in how far enrichment learning using the e-module can influence students' self-regulated learning. In the stage of enrichment learning, the control and experimental class students learn to refer to the 2013 curriculum, The control class was given material of Karangsong mangrove ecosystem, and the experimental class was given enrichment e-module. The stage of Evaluation was aimed to analyze the lack of EMME. The final product was a revised EMME based on students' feedback in the stage of implementation. The research procedure is seen in the following figure.

Data Analysis Techniques

Data analysis techniques include analyzing data of feasibility products, analyzing necessary tests, and analyzing the effectiveness of EMME. The data of the feasibility product was analyzed using descriptive statistics test based on the validation from media experts, material experts, and biology teachers. Analyzing the necessary test used the normality test and homogeneity test. Then, the effectiveness of EMME towards students' self-regulated learning was analyzed through hypothesis test, namely t-test (if data normally distributed) or Mann Whitney test (if data not normally distributed) and normalized-gain test.

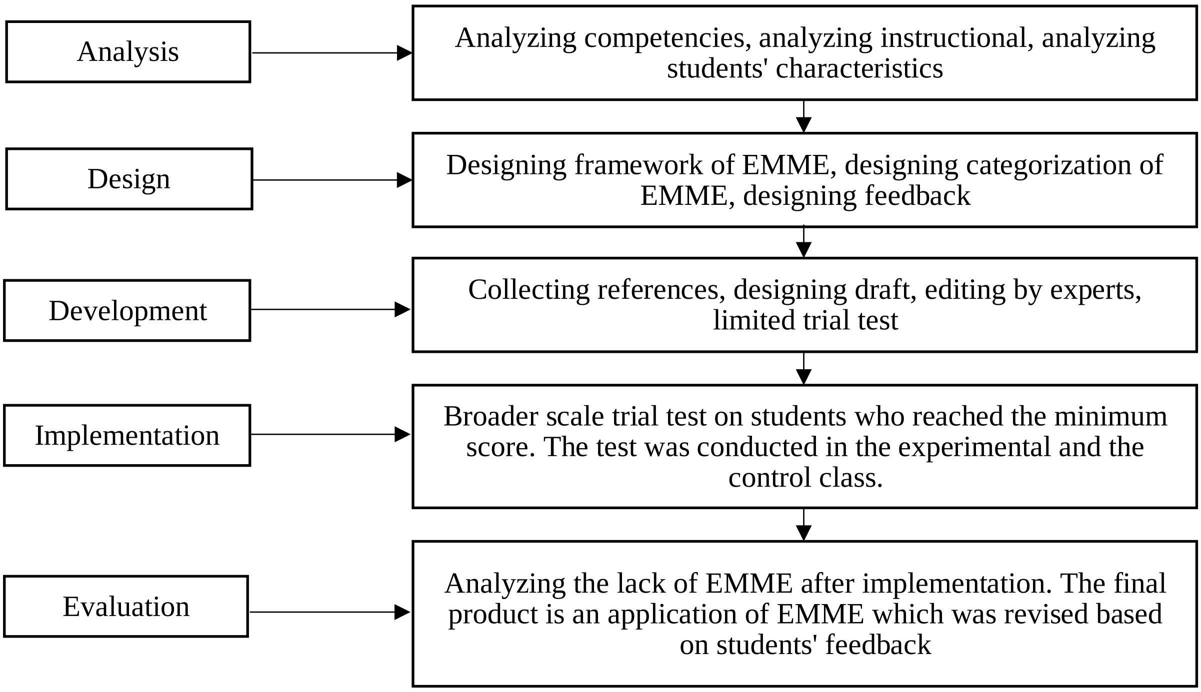


Figure 1. Research Procedure.

RESULTS AND DISCUSSION

Experts Validation

E-module was validated using expert validation. E-module validators were assessed by some experts, namely media experts, material experts, and biology teachers. Validity results based on media experts are presented in Table 2.

Table 2

Validity results by media expert.

No	Indicators	Score	Category
1	The learning indicators are suitable with materials, core and necessary competencies.	87.50	Very feasible
2	The deeper and broader material is suitable with an enrichment program.	91.67	Very feasible
3	The sentence structure is suitable with the rule of the Indonesian language.	91.67	Very feasible
4	The sentence is communicative and suitable for students' cognitive mastery.	66.67	Feasible
5	Categorization in presenting the menu of e-module.	91.67	Very feasible
6	E-module instruction is well presented.	75.00	Feasible
7	Quality of picture, animation, and video.	80.00	Feasible
8	Interesting layout.	95.83	Very feasible
9	Appropriateness in choosing a program .	100.00	Very feasible
10	Easiness and practicality in operation.	75.00	Feasible
	Average	**85.50**	**Very feasible**

Validity results by media experts showed that all indicators belong to the very feasible category, with the average total score of 85.50. It means that the e-module is very feasible to use in learning. The media expert suggested that the competency, which is in the e-module, should be replaced with learning objectives and the module should be added with a website link to enhance students' knowledge. The results of validity by the material expert are presented in Table 3.

Table 3
Validity results by material expert.

No	Indicators	Score	Category
1	Basic competency is suitable with indicators, materials and learning activities.	100.00	Very feasible
2	The material is theoretically right, logic and responsible.	87.50	Very feasible
3	Enrichment material is suitable for students' cognitive development.	100.00	Very feasible
4	Student-centered learning.	100.00	Very feasible
5	The assessment tool is clear and suitable with the indicators.	87.50	Very feasible
	Average	**95.00**	**Very feasible**

Validity results by material experts showed that all indicators are in a very feasible category. It means that the e-module is very feasible to use in learning, in which the average total score is 95.00. Material experts corrected the concept of mangrove forest characteristics. Then, the validation by biology teacher can be seen in Table 4.

Table 4
Validity results by biology teacher.

No	Indicators	Score		Average	Category
		T1	T2		
1	Enrichment material is suitable with core competencies, fundamental competencies, and learning objectives.	100.00	100.00	100.00	Very feasible
2	EMME encourages students to be active in learning.	83.33	91.67	87.50	Very feasible
3	EMME provides new insight and knowledge	83.33	91.67	87.50	Very feasible
4	EMME is useful in learning .	100.00	100.00	100.00	Very feasible
5	The material is suitable for students' understanding level.	95.00	95.00	95.00	Very feasible
6	The use of language is clear, communicative and understandable.	75.00	100.00	87.50	Very feasible
7	The text, picture, and animation are clear.	100.00	100.00	100.00	Very feasible
8	The display is interesting.	91.67	100.00	95.00	Very feasible
	Average			**94.06**	**Very feasible**

Note: T1: Teacher 1, T2: Teacher 2

Validity results by biology teachers show that all indicators are categorized as very feasible. The average total score is 94.06, which means that the e-module is feasible to use in the learning. The teacher gave feedback to add discussion in the application so that the students can examine and evaluate the result of their learning. After experts validated the e-module, the e-module was revised. The revised e-module was then used in the enrichment learning and was tested its effectiveness towards students' self-regulated learning.

Effectiveness of Enrichment E-Module of Mangrove Ecosystem

The effectiveness of Enrichment EMME can be seen from students' self-regulated learning before and after learning. The students' self-regulated learning before and after learning can be seen in Table 5.

Table 5
Students' self-regulated learning

Data	Experimental Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Sample	20	20	22	22
Max. Score	86	91	88	94
Min. Score	63	73	64	69
Average	74.70	79.70	75.50	77.09

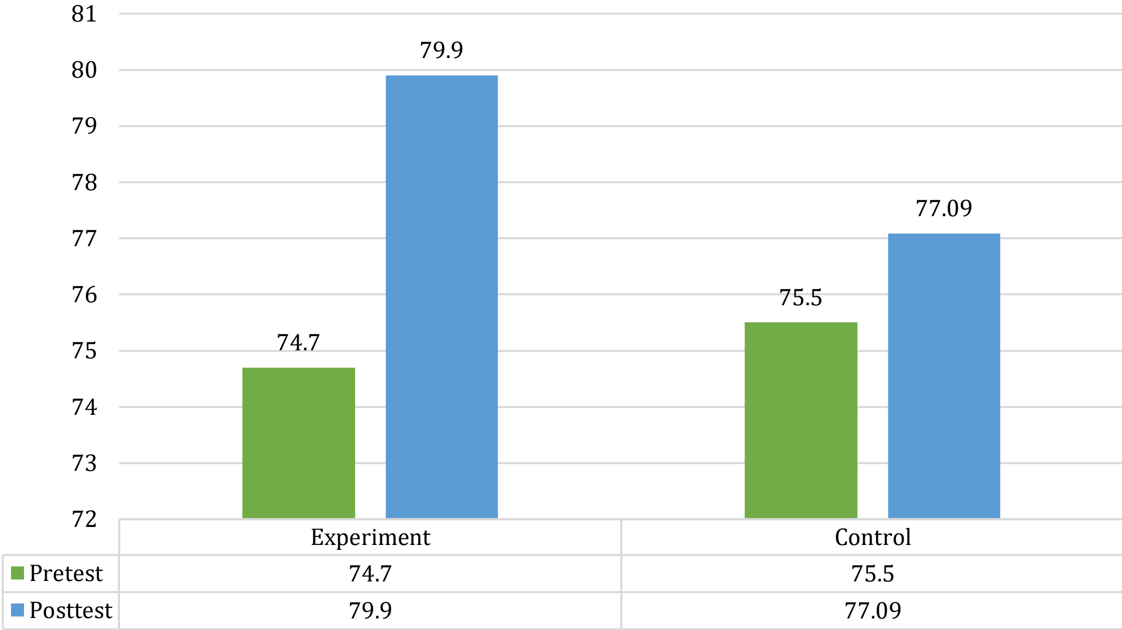


Figure 3. Comparison of self-regulated learning based on indicators.

Data about students' self-regulated learning before enrichment learning presented that the average total score between experimental and control class is not significantly different. It indicated that both classes have the same level of self-regulated learning. That way, the control class can be compared to the experimental class related to students' self-regulated learning.

Hypothesis test can be observed using inferential statistics test. Normality and homogeneity test are also needed to conduct before analyzing the hypothesis test. The result of the normality test is presented in Table 6, and the normality test is presented in Table 7.

Table 6
Result of normality test.

	Class	Signifikansi	Statement
Pretest	Experiment	0.200	Normal
	Control	0.200	Normal
Posttest	Experiment	0.200	Normal
	Control	0.023	Not normal

The normality test showed that the data were not normally distributed in the post-test at the control class with a value of 0.023 < 0.05. In other words, the researchers could not use the t-test. Hypothesis test on the data which are generally not distributed is done by Mann Whitney test.

Table 7

Result of the homogeneity test.

Test	Significance	Statement
Experiment-control	0.377	Homogenous

Significance level showed 0.377 > 0.05 (p>0.05), which means that both groups have homogenous variance. It can be concluded that the experimental and control class come from homogenous populations.

Table 8

Result of Mann Whitney Test

Class	Z	Asymp. Sig (2-tailed)	Statement
Experiment-control	-1.768	0.077	There is no difference.

The analysis result of the normality test indicated that the data were not normally distributed. As a result, the t-test cannot be used as a hypothesis test because the data were not normally distributed, and Mann Whiney test was used as a hypothesis test. Analysis result of the Mann Whitney test showed that the value of Asymp. Sig (2-tailed) is 0.077 > 0.05. Therefore, Ha was rejected, and Ho was accepted. In other words, there was no significant difference between students' self-regulated learning in the experimental class and control class.

Table 9

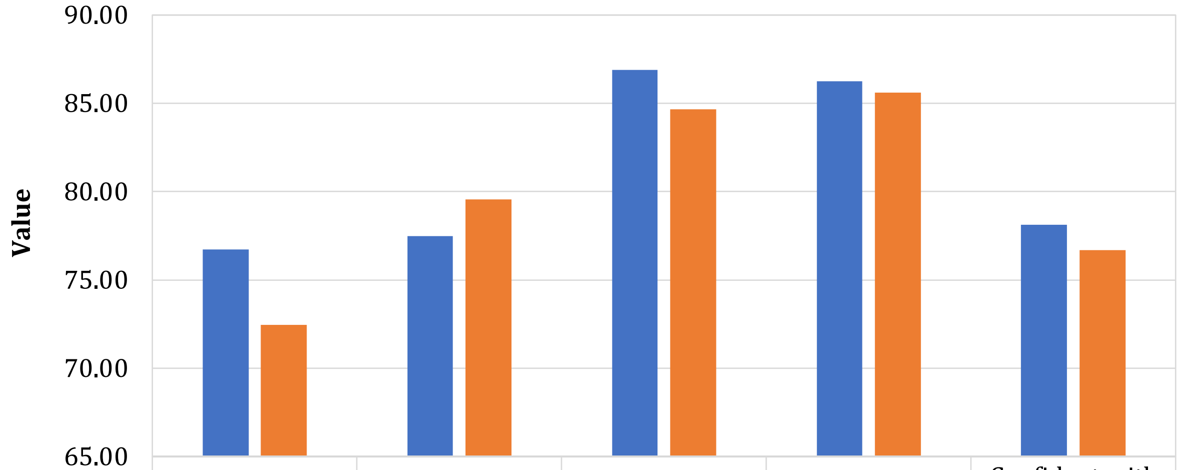
Result of N-Gain

Class	Average	Category
Experiment	0.20	Low
Control	0.06	Low

N-gain score at the experimental class is 0.20, while the N-gain score at the control class is 0.06 (Table 9). These two classes are categorized as low. However, the N-gain score at the experimental class is still higher than at the control class. In other words, the improvement of self-regulated learning at an experimental class is more significant than that of the control class.

EMME was developed based on students' need as a human that has a dependence on technology. Many students use a smartphone for academic purposes (Kwun, Fulk, Alijani, & Kim, 2015). Besides, EMME provides object and subjective symptoms of biology presented in more practical displays through a smartphone (Figure 2), and it contributes positively to biology education to be more productive and efficient. EMME investigates mangrove forest ecosystems around the school, and object and natural symptoms in the Karangsong mangrove forest are presented in a practical and informative way in EMME so that learning biology becomes optimal. EMME has characteristics, namely self-instructional, in which it can train students' independence. The students can freely explore all information regarding the Karangsong mangrove forest; they find out the information by themselves, and they only collect the information through EMME. The use of EMME also motivates the students in that there does not need the teacher's role. As a result, students can be independent (Prastowo, 2015).

Based on the data above, students' self-regulated learning in the experimental class is higher than in the control class. However, the difference in their self-regulated learning is not significant. Many factors influenced its difference when conducting the study, namely short time allocation, learning biology's schedule conducted in a day so that the students felt bored and could not concentrate fully while learning. It caused the students not able to learn independently and optimally. The comparison of students' self-regulated learning based on indicators can be seen in Figure 4.



	Independent	Initiative	Discipline	Responsible	Confident with their ability
Experiment	76.72	77.50	86.88	86.25	78.13
Control	72.44	79.55	84.66	85.61	76.70

Figure 4. The comparison of students' self-regulated learning based on indicators.

In general, self-regulated learning in the experimental class is higher than in control. In each indicator of self-regulated learning, the experimental class has four indicators with a higher value than control class on the aspect of independent, discipline, responsible and confident with their ability. The indicator in the experimental class that has a lower value than in the control class is initiative. As a result, EMME needs to be improved in application and implementation so that all aspects can be optimally increased.

Biology learning activity using EMME can enhance students' self-regulated learning. The students in the experimental class are exposed to understand the material content outside the classroom independently, to find the resource or additional information, to solve problems, and to do the exercise independently. The teacher is only obliged to assist the students when they find difficulties. This learning can encourage students not to depend on the teacher, and they can learn using EMME and other resources as additional information. The fruition is in line with a study conducted by (Prastowo 2012), e-module is designed for students to learn without guidance from the teacher.

Moreover, EMME has "self-instructional" characteristic that enables students not to depend on others (Daryanto, 2013; Purwanto & Lasmono, 2007; Widodo & Jasmadi, 2008). EMME leads the students to do activities lead by themselves, to understand the material, find out the information, and exercise so that they do not depend on others. Goodman & Smart (1999) also has the same argument that self-regulated learning includes the aspect of independence, a behavior in which its activities are led to oneself.

EMME design in brief, informative, and flexible so that its use depends on one's consciousness to do something. The students have to be more initiative to do the independent learning activity. The students who have initiative will learn to utilize EMME as an instrument in increasing their knowledge. Brookfield & Votruba (1987) also declared that self-regulated learning is regarding consciousness to achieve an objective. Materials presented in EMME are designed in a contextual concept. The questions are presented in a picture of real life happened in a mangrove forest, and it will rain students' initiative in order to find a new method in solving their daily life problems. Also, initiation is the ability to develop an idea and a new method in solving problems (Suryana, 2006). In the indicator of 'initiative,' the experimental class has a lower value than the control class. It might be because the students in the experimental class learned with little assistance from the teacher. The teacher only gave few instructions and did not give the task in specific activity so that the students felt that they were not controlled by the teacher that leads them not to have an initiation to do self-regulated learning.

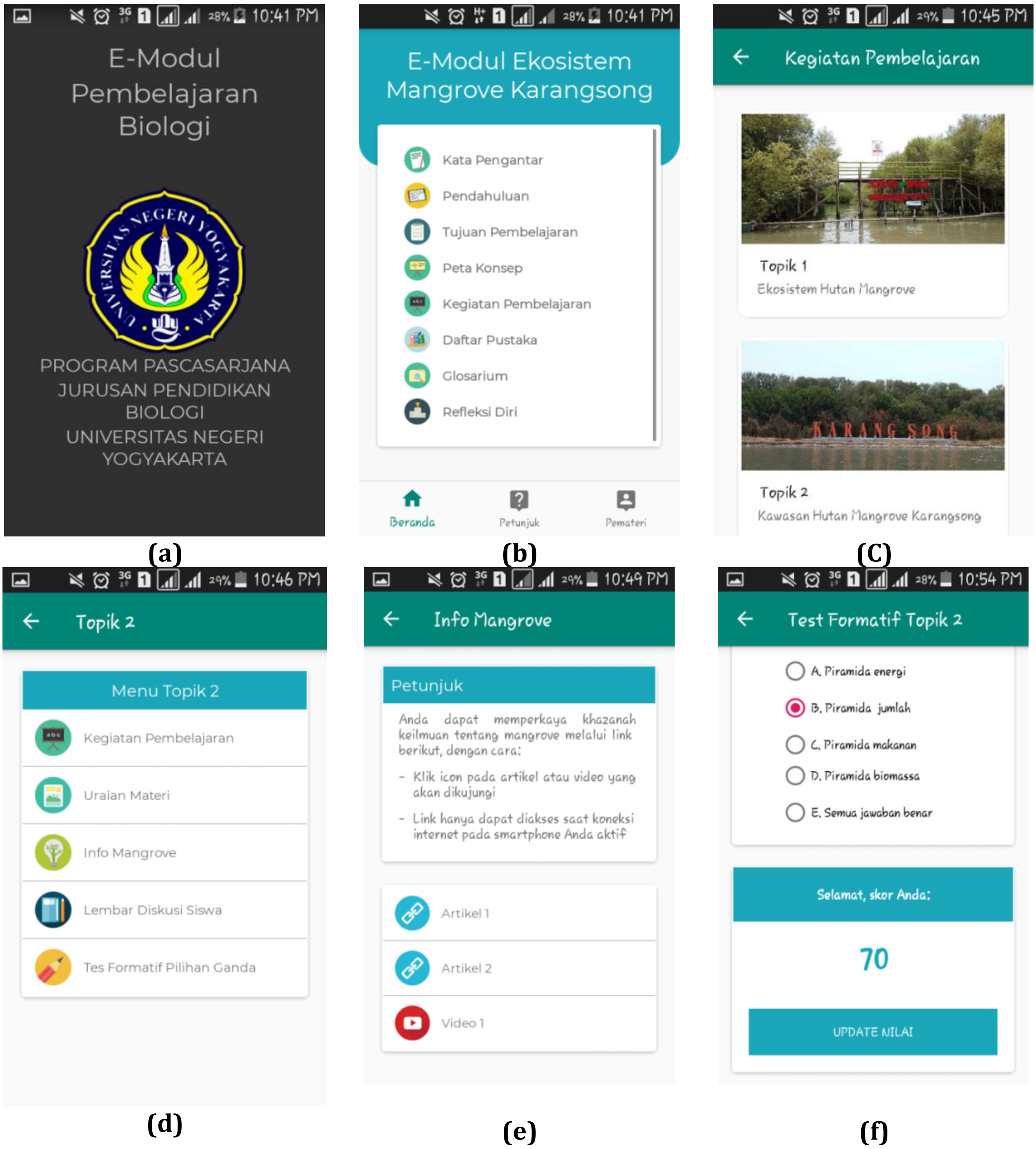


Figure 2. Display of EMME, (a) frontpage, (b) homepage, (c) menu of learning activity, (d) Topic 2 menu, (e) mangrove info menu, and (f) feedback menu.

Discipline in learning is students' desire to learn, which is encouraged by themselves. Indicator 'discipline' in the experimental class is higher than in the control class. EMME provides students with various learning styles so that they can organize their learning schedules based on their needs and learning styles. Besides, students are trained to be disciplined in learning, designed to assign their tasks in time.

EMME allows the students to be responsible for independent exercise in their learning. The students in the experimental class have a higher responsibility level than in the control class. EMME can help students see how far the students follow the learning activities appropriate for EMME rules and instruction, to see their seriousness in learning, to understand the material independently, and not given the materials and understanding in a conventional method. More importantly, the students are encouraged to be responsible for assigning their exercise without others' assistance. Moore & Diehl (2018) stated that self-regulated learning gives freedom and responsibility in the learning process.

In indicator 'confident with their ability,' the students in the experimental class had a higher value than in the control class. Learning using EMME enables students not to depend on others. This condition creates the students to be tough and independent so that the students have to be confident with their abilities in learning and accomplishing their learning exercise. This is in line with a study from Pratiwi & Laksmiwati (2016), the higher their self-confidence they have, the higher their learning independence. Another implementation of confidence is its ability to give arguments or opinions. EMME features a reflection menu that can be filled by the students. Therefore, the students can deliver their opinions, such as feedback, suggestion, and anything obtained through EMME.

CONCLUSION

Based on the results of this study, EMME is feasible to be use in enrichment learning at school. N-gain score in the experimental class was higher than in the control class, and the result of the hypothesis test showed the difference, which was not significant on the students' self-regulated learning in the experimental and control class. Learning using EMME was not optimal yet in increasing students' self-regulated learning at X class of a Senior High School in Sindang, Indramayu, Indonesia. Time allocation in learning using EMME should be added to make the learning more effective to increase students' self-regulated learning. This study's product is expected to be shared with teachers and students for enrichment learning in other schools on the same topic.

ACKNOWLEDGMENT

The authors would like to acknowledged Dr. Paidi, M.Si dan Dr. Ir. Suhartini, M.S as validator who has suggested and given feedbacks on validating the instruments and product of this study. The researchers also thank Inna Nurfebriani, S.Pd, and Listia Eka Suci Septiani, S.Pd as a biology teacher. Who have given the facilities and helped the researchers in conducting this study at their school.

REFERENCES

Agustihana, S., & Suparno. (2018). Effectiveness of physics mobile learning media to improve higher order thinking skills of students in thermodynamics. *Journal of Physics: Conference Series*, *1097*(1), 1–9. https://doi.org/10.1088/1742-6596/1097/1/012031

Arain, D. A. A., Hussain, Z., Rizvi, W. H., & Vighio, M. S. (2017). An analysis of the influence of a mobile learning application on the learning outcomes of higher education students. *Universal Access in the Information Society*, *17*(2), 325–334. https://doi.org/10.1007/s10209-017-0551-y

Badola, R., & Hussain, S. A. (2005). Valuing ecosystem functions: An empirical study on the storm protection function of Bhitarkanika mangrove ecosystem, India. *Environmental Conservation*, *32*(1), 85–92. https://doi.org/10.1017/S0376892905001967

Bahreman, V., Chang, M., Amistad, I., & Garn, K. (2016). *Investigating Determinants of Video-Based Learning Acceptance Investigating Determinants of Video-Based Learning Acceptance Intention Technology acceptance Adoption factors Determinants*. In *State-of-the-Art and*

Future Directions of Smart Learning (Issue October, pp. 293–296). Springer-Verlag Singapura. https://doi.org/10.1007/978-981-287-868-7

Barnard-Brak, L., Paton, V. O., & Lan, W. Y. (2010). Profiles in self-regulated learning in the online learning environment. *International Review of Research in Open and Distributed Learning, 11*(1), 61-80. https://doi.org/10.19173/irrodl.v11i1.769

Bartolome, A., & Steffens, K. (2011). *Technologies for Self-Regulated Learning. In Self-Regulated Learning in Technology Enhanced Learning Environments* (pp. 155–163). Sense Publisher. https://doi.org/10.1007/978-94-6091-654-0_10

Beishuizen, J., & Steffens, K. (2011). A conceptual framework for research on self-regulated learning. *In Technology Enhanced Learning* (pp. 3–23). Sense publishers. Retrieved from https://brill.com/view/book/edcoll/9789460916540/BP000002.xml

Brookfield, S. D., & Votruba, J. (1987). Understanding and facilitating adult learning. *The Journal of Higher Education*, *58*(5), 602. https://doi.org/10.2307/1981795

Daryanto. (2013). *Menyusun Modul Bahan Ajar untuk Persiapan Guru dalam Mengajar*. Gave Media.

Dettori, G., & Persico, D. (2011). *Fostering self-regulated learning through ICT*. Information Science Reference. https://doi.org/10.4018/978-1-61692-901-5

Dick, W., & Carey, L. (1996). *The Systematic Design of Instruction*. Harper Collin.

Effeney, G., Carroll, A., & Bahr, N. (2013). Self_regulated learning key strategies and their sources. *Australian Journal of Educational & Developmental Psychology*, *13*, 58–74. Retrieved from www.newcastle.edu.au/journal/ajedp/

Elkhateeb, M., Shehab, A., & El-Bakry, H. (2019). Mobile learning system for egyptian higher education using agile-based approach. *Education Research International*, *2019*(June 2004), 2020. https://doi.org/10.1155/2019/7531980

Fatkhiyani, K., & Suhada, D. (2018). Utilization of Karangsong Beach as a learning resources based on local wisdom in improving understanding of the concept students of primary teacher education. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *8*(3), 185–192. https://doi.org/10.30998/formatif.v8i3.2930

Furió, D., Juan, M. C., Seguí, I., & Vivó, R. (2015). Mobile learning vs. traditional classroom lessons: A comparative study. *Journal of Computer Assisted Learning*, *31*(3), 189–201. https://doi.org/10.1111/jcal.12071

García-Peñalvo, F. J., & Conde, M. (2015). The impact of a mobile personal learning environment in different educational contexts. *Universal Access in the Information Society*, *14*(3), 375–387. https://doi.org/10.1007/s10209-014-0366-z

Goodman, & Smart. (1999). *Emotional Intelligence*. Bantam Books.

Hadiana, & Samosir, A. M. (2015). The desain of mangrove conservation area to increase resilience of Cimanuk Delta, Indramayu, West Java to climate change. *Bonorowo Wetlands*, *5*(2), 63–76. https://doi.org/10.13057/bonorowo/w050202

Hadianti, S., Azrai, E. P., & Sukandar, P. (2014). The Correlation between conservation knowledge and fisherman perception about mangrove plantation activities on Kampung Garapan, Desa Tanjung Pasir, Tangerang. *Biosfer: Jurnal Pendidikan Biologi, 7*(2), 10-14. https://doi.org/10.21009/biosferjpb.7-2.3

Hapsari, N. (2016). Pengembangan E-modul Pengayaan Materi Pertumbuhan dan Perkembangan untuk Meningkatkan Kemandirian Hasil Belajar. *Jurnal Pendidikan BIologi*, *5*(5), 23–31. Retrieved from http://journal.student.uny.ac.id/ojs/index.php/pbio/article/view/4557/4225

Herawati, N. T. (2017). The Implementation of self regulated learning model using ict media toward the students achievement in introduction to accounting course. *Journal of Accounting and Business Education,* *2*(1), 144-157. http://dx.doi.org/10.26675/jabe.v1i1.9755

Hidayati, N., Pangestuti, A. A., & Prayitno, T. A. (2019). Edmodo mobile: developing e-module biology cell for online learning community. B*iosfer: Jurnal Pendidikan Biologi, 12* (1), 94-108. https://doi.org/10.21009/biosferjpb.v12n1.94-108

Hsu, Y. C., & Ching, Y. H. (2013). Mobile app design for teaching and learning: Educators' experiences in an online graduate course. *International Review of Research in Open and Distance Learning*, *14*(4), 117–139. https://doi.org/10.19173/irrodl.v14i4.1542

Jeske, D., Backhaus, J., & Roßnagel, C. S. (2014). Self-regulation during e-learning: using behavioural evidence from navigation log files. *Journal of Computer Assisted Learning, 30*(3), 272-284. https://doi.org/10.1111/jcal.12045

Karimah. (2017). Peran Ekosistem Hutan Mangrove Sebagai Habitat Untuk Organisme Laut. *Jurnal Biologi Tropis*, *17*(2), 51–58. http://dx.doi.org/10.29303/jbt.v17i2.497

Kismiati, D. A. (2018). *Pengembangan e-modul pengayaan isolasi dan karakterisasi bakteri sebagai sumber belajar biologi untuk meningkatkan kemandirian dan hasil belajar kognitif siswa SMA kelas X di SMAN 1 Jetis Bantul*. (Thesis unpublished), Universitas Negeri Yogyakarta, Yogyakarta.

Kwun, O., Fulk, H. K., Alijani, G. S., & Kim, H. (2015). Understanding successful use of smartphones in an academic context: HBCU students' perspective. *Academy of Educational Leadership Journal*, *19*(3), 175–185. Retrieved from https://search.proquest.com/openview/f2e778e2d6915a825bbb6713288308a4/1?pq-origsite=gscholar&cbl=38741

Maryono. (2016). The Implementation of Schools' Policy in the Development of the Local Content Curriculum in Primary Schools in Pacitan, Indonesia. *Educational Research and Reviews*, *11*(8), 891–906. Retrieved from https://files.eric.ed.gov/fulltext/EJ1099994.pdf

Moore, M. G., & Diehl, W. C. (2018). *"Charles A. Wedemeyer", in Handbook of Distance Education*. Routledge. https://doi.org/10.4324/9781315296135

Mueller, M. P., & Tippins, D. J. (2010). Van Eijck and Roth's utilitarian science education: why the recalibration of science and traditional ecological knowledge invokes multiple perspectives to protect science education from being exclusive. *Cultural Studies of Science Education*, *5*(4), 993–1007. https://doi.org/10.1007/s11422-009-9236-z

Müller, N., & Faltin, N. (2011). IT-support for self-regulated learning and reflection on the learning process. *ACM International Conference Proceeding Series*, *September 2014*. https://doi.org/10.1145/2024288.2024299

Nussbaumer, A., Dahn, I., Kroop, S., Mikroyannidis, A., & Albert, D. (2015). *Supporting Self-Regulated Learning. In Responsive Open Learning Environments: Outcomes of Research from the Role Project* (pp. 17–48). https://doi.org/10.1007/978-3-319-02399-1_2

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research. *Frontiers in Psychology*, *8*(APR), 1–28. https://doi.org/10.3389/fpsyg.2017.00422

Pechenkina, E., Laurence, D., Oates, G., Eldridge, D., & Hunter, D. (2017). Using a gamified mobile app to increase student engagement, retention and academic achievement. *International Journal of Educational Technology in Higher Education*, *14*(31), 1–12. https://doi.org/10.1186/s41239-017-0069-7

Perez-Alvarez, R., Maldonado-Mahauad, J., & Perez-Sanagustin, M. (2018). Tools to support self-regulated learning in online environments: literature review. *Lifelong Technology-Enhanced Learning*, *11082*(01), 277–290. https://doi.org/10.1007/978-3-319-98572-5

Prastowo, A. (2012). *Pengembangan Bahan Ajar Tematik*. Kencana Prenadamedia Group.

Prastowo, A. (2015). *Panduan kreatif membuat bahan ajar inovatif*. Diva Press.

Pratiwi, I. D., & Laksmiwati, H. (2016). Kepercayaan diri dan kemandirian belajar pada siswa sma negeri "x". *Jurnal Psikologi Teori Dan Terapan*, *7*(1), 43. https://doi.org/10.26740/jptt.v7n1.p43-49

Purwanto, R. A., & Lasmono, S. (2007). *Pengembangan Modul*. Pusat Teknologi Informasi dan Komunikasi Pendidikan Departemen Pendidikan Nasional.

Puspadita, D. D. (2018). *Hubungan kemandirian belajar dan fasilitas belajar dengan hasil belajar biologi kelas xi ipa sma n 2 koto xi tarusan skripsi*. Sekolah Tinggi Keguruan dan Ilmu Pendidikan. Retrieved from http://repo.stkip-pgri-sumbar.ac.id/id/eprint/6241/4/12010089%20DEASTY%20DWI%20PUSPADITA%20SKRIPSI.pdf

Rijal, S., & Bachtiar, S. (2015). Hubungan antara sikap, kemandirian belajar, dan gaya belajar dengan hasil belajar kognitif siswa. *Jurnal Bioedukatika*, *3*(2), 15. https://doi.org/10.26555/bioedukatika.v3i2.4149

Ristanto, R. H., Miarsyah, M., Muharomah, D. R., Astuti, T. A., & Aini, S. Prihatin., AI (2019). Light-Board: simple media to learn photosynthesis concepts. International Journal of *Advanced Trends in Computer Science and Engineering,* *9*(1), 299-303. https://doi.org/10.30534/ijatcse/2020/45912020

Sarrab, M., Alzahrani, A., Alalwa, N., & Alfarraj, O. (2014). From traditional learning into mobile learning in education at the university level: Undergraduate students perspective. *International Journal of Mobile Learning and Organisation*, *8*(3), 167–186. https://doi.org/10.1504/IJMLO.2014.067014

Shih, K., Chen, H., Chang, C., & Kao, T. (2016). International forum of educational technology & society the development and implementation of scaffolding-based self-regulated learning system for e / m-learning. *Educational Technology & Society*, *13*(1), 80–93. Retrieved from https://www.jstor.org/stable/10.2307/jeductechsoci.13.1.80

Sun, Y. (2019). Investigation into the android-based mobile learning system. *Theory and Practice in Language Studies*, *9*(6), 712–717. https://doi.org/10.17507/tpls.0906.15

Suratsih. (2010). *Pengembangan Modul Pembelajaran Biologi Berbasis Potensi Lokal dalam Kerangka Implementasi KTSP SMA di Yogyakarta*.

Suryabrata. (2002). *Psikologi Pendidikan*. PT. Grafindo Perkasa Rajawali.

Suryana. (2006). *Kewirausahaan Pedoman Praktis: Kiat dan Proses meuju Sukses*. Salemba.

Widodo, C. S., & Jasmadi. (2008). *Buku Panduan Menyusun Bahan Ajar*. PT Elex Media Komputindo.

Windyariani, S. (2017). Kemampuan literasi sains siswa sd pada konteks melestarikan capung. *Biosfer: Jurnal Pendidikan Biologi, 10*(1), 17-21. https://doi.org/10.21009/biosferjpb.10-

1.3

Yau, J. Y.-K., & Hristove, Z. (2017). Evaluation of an extendable context-aware “learning java” app with personilez user profilingEvaluation of an extendable context-aware “learning java” app with personilez user profiling. *Technology, Knowledge and Learning*, *23*(4), 315–330. https://doi.org/10.1007/s10758-017-9339-7

Zimmerman, B. J. (1990). Self-regulated learning and academic achievement: an overview. *Educational Psychologist*, *25*(1), 3–17. https://doi.org/10.1207/s15326985ep2501_2

Zimmerman, B. J. (2000). Attaining Self-Regulation. Handbook of Self-Regulation. In *Educational Psychologist*. https://doi.org/10.1016/b978-012109890-2/50031-7