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Development of mangrove ecosystem e-encyclopedia as learning sources to improve information literacy skills and environmental care attitudes of students

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Abstract: This study aims to produce a viable and effective product for science learning in schools. The product developed is an e-encyclopedia of mangrove ecosystems. This study uses the Research and Development (R&D) model developed by Borg & Gall. The stages of development of Borg & Gall used in this research are; (1) research and information collecting; (2) planning; (3) developing preliminary; (4) preliminary field testing; (5) primary product revision; (6) field testing; (7) operational product; (8) field product revision; and (9) dissemination. The subjects of the limited trial consisted of 15 students of class VII. In comparison, the field trial consisted of 52 students from VII-G and VII-E of a school in Yogyakarta. The data collection instruments included interviews, field observations, information literacy evaluation questions, and student environmental care attitude questionnaires. The field trial design uses a pretest-posttest control group design. The results show that: (1) the developed mangrove ecosystem e-encyclopedia is very suitable for use in science learning; (2) the e-encyclopedia of mangrove ecosystems is effective in improving students' information literacy skills and environmental care attitudes. Product eligibility is based on the assessment of experts and practitioners in the school. Product effectiveness is based on Manova test results with a significance of less than 0.05 and the results of the effect size analysis. The effect size value for information literacy skills of 0.18 belongs to the high category, and 0.029 for environmental care attitude is included in the small category.

Keywords: E-encyclopedia, Environmental Care Attitude, Information Literacy, Mangrove Ecosystem, Reference Source.

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INTRODUCTION

Providing adequate learning resources is an essential component of the learning process. Learning resources are all sources of messages, people, materials, tools, techniques, and settings that students can use independently and in groups for teaching and learning activities and improving learning performance (Supriadi, 2017).

The learning resources around students are diverse, but the learning resources used are generally still limited to textbooks. The interviews with teachers at a school in Yogyakarta show that the commonly used learning resources are textbooks from the Education Office. Efforts to utilize various natural objects in the environment and society as an alternative source of learning in schools have not been carried out widely. The learning resources teachers and students use are dominant in textbooks (Kahar, 2018). Therefore, other learning resources are needed to make it enjoyable and enrich students' knowledge.

Reference sources are non-text books containing material that can obtain answers or clarity specific knowledge. The presentation of material in reference books is arranged systematically so that

readers can find it quickly and precisely. Reference sources can provide basic information that becomes a reference when people try to understand a general or specific term or concept. An encyclopedia is an interesting reference book for student learning (Wismarini et al., 2012).

Along with the development of technology and information, encyclopedias can take advantage of relevant information technology. The rapid advancement of technology changes traditional ways to become modern with the services provided by technology and information (Gyaase, 2013). Encyclopedias in the form of books alone will not compete with other technology products. Therefore, an encyclopedia in electronic form is needed to present complex information, both sound, video, games, animation, and others, to become more interactive and fun (Wismarini, 2012). One ideal technology medium to integrate and disseminate learning information is the web. The web provides exceptional facilities for various data types and media text, voice, video, and others (Scott, 2012). Encyclopedias that use the internet network are then called e-encyclopedias or electronic encyclopedias.

The material presented in the e-encyclopedia reference source is about the mangrove ecosystem. The mangrove ecosystem is one of Indonesia's natural resources, essential for coastal ecosystems. However, the learning curriculum does not include the mangrove ecosystem material. Based on interviews with teachers of the school, so far, there are still limited learning resources that discuss the mangrove ecosystem, let alone electronic ones. Concerning ecosystem materials, most students have achieved the Minimum Completeness Criteria (KKM), so additional learning resources are needed that add insight to students. The existence of mangrove ecosystem material can enrich students' understanding so that students' sense of ecosystems is not limited to textbooks from the department.

Learning about ecosystems by utilizing e-encyclopedia learning resources, among others, aims to improve information literacy and students' environmental care attitudes. The information age makes it easy for everyone to get information (information is everywhere). Students can use computers, laptops, and smartphones proficiently without being guided by teachers or parents. The school also has a computer laboratory and a good wifi network for learning. Ease of access to information is an opportunity and a threat for students because not all available information is quality, valid, and reliable (Prasetyawan, 2018). Based on the results of interviews with science teachers at the school, the practice of information literacy with electronic learning resources has not become a particular program in schools. The literacy program that has been running reads literacy every morning and during breaks. Students have not been trained to manage information online.

A person's attitude towards the environment is strongly influenced by the knowledge and information he obtains (Harun, 2011). One of the factors that cause the low attitude of caring for the environment is students' lack of knowledge about the problems in the surrounding environment (Nasution, 2016). Based on the interviews with teachers at the school, many students are still not sensitive to the surrounding environment. The teacher must remind the students to picket and clean the classroom before leaving. In addition, there is a lot of food waste cleaned by the school cleaners. This condition shows the students' lack of awareness of the surrounding environment. Based on the description above, a solution is needed to improve information literacy skills and environmental care attitudes. Therefore, the researcher produces an e-encyclopedia of mangrove ecosystems that is feasible and effective in improving information literacy skills and students' environmental care attitudes.

Wismarini (2012) and Kahar (2018) conduct research relevant to this research. Wismarini conducted research entitled Electronics Encyclopedia of Herbs as a Digital Data Bank of Medicinal Plants. This research resulted in an Electronic Encyclopedia of Plants Web-based Herbs (EETH), one of the efforts to document and inform the public about various medicinal plants. Adi Pasah Kahar applied mangrove ecosystem teaching materials based on the local potential to increase the environmental care attitude among students. The research concludes that applying teaching materials for mangrove ecosystems based on local potential can improve students' environmental care.

METHOD

Development Procedure

This research is a Research and Development (R&D) research with the Borg & Gall development model. The product developed is an e-encyclopedia of mangrove ecosystems. The stages of development of Borg & Gall used in this research are; (1) collecting information ; (2) planning; (3) developing

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preliminary; (4) preliminary field testing; (5) primary product revision; (6) main field testing; (7) operational product; (8) field product revision; and (9) dissemination.

Initial product development trials were carried out in a limited trial involving 15 seventh-grade students of a school in Yogyakarta. The researcher gave a readability questionnaire of the e-encyclopedia of mangrove ecosystems. Furthermore, the field test was carried out with a quasi-experiment. The field trial design used was the pretest-posttest control group design. The description of the treatment in limited and field trials is explained in Table 1.

Table 1. The description of the treatment in limited and field trial

Research Stage	Treatment	Sample Demography
Limited trial	The student filled out a readability questionnaire of the e-encyclopedia of mangrove ecosystems.	Consist of 15 students from class VII D. All the participants are male. They have different academic abilities.
Field trial	Students from the control class used commonly used learning resources, while the experimental class used the mangrove ecosystem e-encyclopedia learning resource.	Two classes are the control and the experimental class. The control class consisted of 26 students from class VII G, while the experimental class consisted of 26 students from class VII E. Two classes have similar average academic abilities. All the participants of the field trial are female.

The results obtained from the experiment were then processed and analyzed using the SPSS 25 statistical application.

Data Collection Techniques and Instruments

This study's data collection techniques include interviews, observations, environmental care attitude questionnaires, and essay question sheets on evaluating students' information literacy skills. The instruments used are (1) a preliminary direct interview to know about the environmental care attitude and information literacy skills of the students, (2) product assessment sheets for media experts, material experts, and teachers, (3) lesson plans assessment sheets, (4) product readability sheets by students, (5) attitude questionnaire sheets care for the environment of students, and (6) a matter of evaluating students' information literacy skills. All the instruments use multiple choice except the information literacy skills instrument. The sheet consists of 7 very easy, easy, and medium. The lattices for evaluating information literacy skills and students' environmental care attitude questionnaires are listed in Tables 2 and 3.

Table 2. Student Information Literacy Skills Evaluation Grid

Assessment Aspect	Rating Indicator	Number
Formulation of the problem	Encyclopedias teach students to find problems from reading and illustrations	1
	Encyclopedias teach students to identify problems through questions	2
Information search strategy	Encyclopedia trains students to find sources of information	3
Location and access	Train students to find the information they are looking for in these sources	4
Use of information	Train students to use the information to solve environmental problems.	5
Information synthesis	Presenting the information that has been obtained	6
Evaluation	Evaluating the results of problem-solving with information sources	7

Adapted from Riski (2018).

Table 2. Questionnaire Grid of Students' Environmental Care Attitude

Poin	Assessment Aspect	Question Points
1	Behaviour to maintain cleanliness	14
2	Attitude to energy	4
3	Attitude toward land, water, and air	10
4	Attitude towards flora and fauna (including mangrove ecosystem)	12
5	Attitude toward people and the social environment	12

Adapted from Istiqomah (2019).

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A validity test determines the feasibility of the instrument questions to be given to the students. The validator lecturer carries out content and constructs validity. The lecturers give an assessment and input on the feasibility of media and materials in the ecosystem of e-encyclopedia mangroves. The lecturers fill out an assessment sheet based on indicators and provide feedback for product improvement—the media and material expert validation grid in Tables 4 dan 5.

Table 4. Media Expert Validation Grid

No.	Aspect
1.	Graphic
2.	Instructional component

Table 5. Material Expert Validation Grid

No.	Aspect
1.	Content eligibility components
2.	Serving components
3.	Linguistic component

The product's practicality is based on the assessment of the two science teachers, while the readability of the product is based on the assessment of 15 students at the school. The teachers and the students filled out a questionnaire about the product. The grid of the practicality and readability product is in Tables 6 and 7.

Table 6. Practicality Test Grid by Science Teachers

Numb.	Aspect
1.	Content eligibility components
2.	Serving components
3.	Linguistic component
4.	Graphic component
5.	Instructional components

Table 7. Readability Test Grid by Students

Numb.	Aspect
1.	Content eligibility components
2.	Serving components
3.	Linguistic component

The empirical validity test was carried out using Anates item analysis application 4.0.2. Empirical test results are the reliability of the questions, discrimination index, and difficulty level obtained from questions carried out to evaluate student information literacy. The measurement results of the question reliability are 0.83, which is included in the very high category. The measurement results of the discrimination index are contained in Table 8.

Table 8. The measurement result of the discrimination index

Number	Score	Level
1	0, 72	Very good
2	0, 56	Very good
3	0, 60	Very good
4	1, 04	Very good
5	0, 52	Very good
6	1, 36	Very good
7	0, 40	Very good

The measurement results of the question difficulty level are contained in Table 9.

Table 9. The measurement result of the question difficulty level

Number	Score	Level
1	0, 66	Medium
2	0, 72	Easy

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Number	Score	Level
3	0, 50	Medium
4	0, 66	Medium
5	0, 82	Easy
6	0, 50	Medium
7	0, 86	Very Easy

Data Analysis

The product feasibility questionnaire uses the Guttman scale with an answer choice of "Yes" with a score of 1 and "No" with a score of 0. The equation for calculating the average score of the assessment is as follows:

$$\bar{X} = \frac{\sum Xi}{N}$$

where $\bar{X}$ is the mean score; ΣXi is the total score of each component; and N is the number of raters.

Qualitative data was obtained by changing the score from the above equation into interval data with a scale of four. The guidelines for scoring categories are in Table 10.

Table 10. Category Five Scale Score

Score range formula	Category
$X > Xi + 1{,}8\ Sbi$	Very Suitable
$Xi + 0{,}60\ Sbi < X \leq Xi + 1{,}8\ Sbi$	Suitable
$Xi - 0{,}60\ Sbi < X \leq Xi + 0{,}60\ Sbi$	Decent enough
$Xi - 1{,}8\ Sbi < X \leq Xi - 0{,}60\ Sbi$	Less Suitable
$X \leq Xi - 1{,}8\ Sbi$	Very Less Suitable

Analysis of the effectiveness of the mangrove ecosystem e-encyclopedia product was used to see the product's effectiveness in improving students' information literacy skills and environmental care attitudes. The value data used in assessing the product's effectiveness are the results of the pretest and posttest of information literacy skills and students' environmental care attitudes. The evaluation of students' information literacy skills uses an evaluation question in the form of a description, while the evaluation of environmental care attitudes uses a questionnaire. The difference in values before and after learning can be seen from the expected gain value. The standard gain equation is as follows:

$$g = \frac{Posttest\ Score - \ Pretest\ Score}{\max score - Pretest\ Score}$$

where $<g>$ is gain score.

Furthermore, the Manova test (Multivariate Analysis of Variance) was carried out to see the difference in values between the control and experimental groups with information literacy variables with environmental care attitudes simultaneously. The Manova test was carried out after the data met the Manova prerequisite test.

The final step after the Manova test is an effect size analysis. Effect size is a measure of the magnitude of the influence of one variable on other variables. Determination of effect size in this study was conducted to determine the effect of e-encyclopedia of mangrove ecosystems on each variable of information literacy skills and students' environmental care attitudes. Effect size can be known from the value of partial eta squared. The interpretation of effect size with partial eta squared based on Cohen's is in Table 11.

Table 11. Cohen's Value Interpretation Criteria

Value	Category
$\eta^2 \geq 0{,}14$	Big
$0{,}06 \leq \eta^2 < 0{,}14$	Currently
$0{,}01 \leq \eta^2 < 0{,}06$	Small
$\eta^2 < 0{,}01$	No influence

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RESULTS AND DISCUSSION

Product Development

The product developed in this research is an e-encyclopedia of mangrove ecosystems. The product is a reference in biology learning, especially in interacting with living things and the environment. Product development aims to improve students' information literacy skills and environmental care attitudes. This product development uses the Borg and Gall development model.

Product development is carried out following a preliminary study at a school in Yogyakarta. The science learning curriculum used at the is the 2013 curriculum. The students use books from government agencies as the primary source of guidance in science learning. Teachers also use online learning resources from websites, journals, and others to broaden students' knowledge. Students generally have achieved the Minimum Completeness Criteria (KKM), especially in interacting with living things and their environment. However, additional knowledge is needed so that students' insight is not limited to the material contained in the handbook.

Regarding the profile of students' information literacy skills, the school has provided a literacy hour facility where students can seek information from various sources available in the school library. However, due to the Covid-19 pandemic, the students cannot do the literacy hour. Online learning facilities are essential to access information from their respective homes. In addition to information literacy skills, another aspect that needs to be closely monitored is the student's environmental care attitude. The teacher must remind students to clean pickets every time the lesson ends.

The product development planning stage includes content structure analysis, learning objectives analysis, and concept analysis. Content analysis is carried out to determine Core Competencies (KI), Basic Competencies (KD), and indicators that follow the material to interact with living things and the environment. The selection of KI, KD, and indicators also pays attention to information literacy skills and environmental care attitudes. Concept analysis elaborates KI and KD in a more specific concept map of learning materials. The concept map of the material developed is shown in Figure 1.

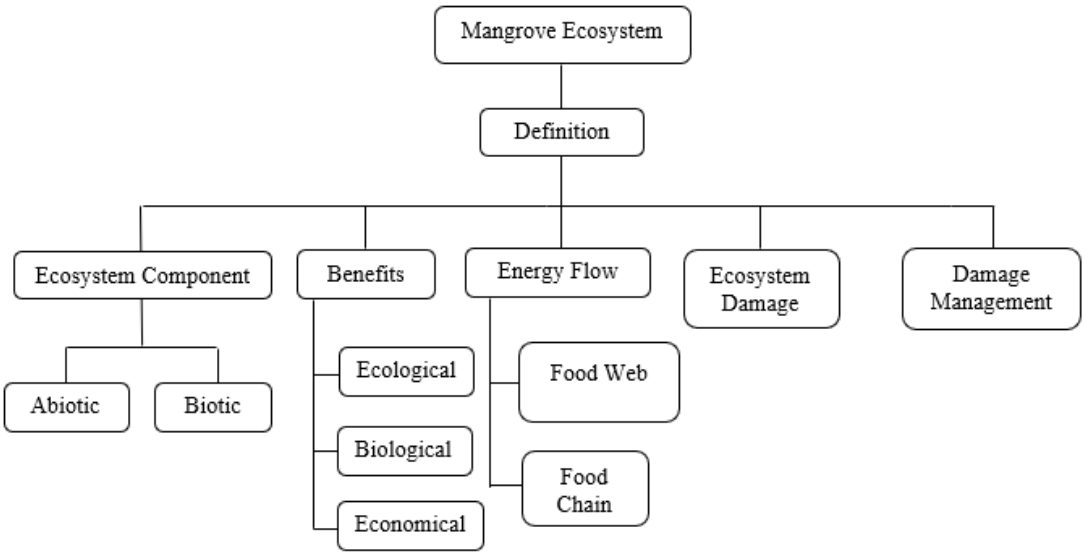

Figure 1. Mangrove Ecosystem Material Concept Map

Learning objectives are analyzed by describing KI, KD, and indicators in learning objectives. Furthermore, material analysis is carried out to describe the interaction of living things with the environment in interrelated facts, concepts, and principles.

The initial product development stage includes media selection, framework preparation, and e-encyclopedia draft. The selected media is website-based with the .id domain. Media websites allow students to access material equipped with images, sound, and video illustrations. The website can be used as an online learning medium, especially during the Covid-19 pandemic. In addition, the website can be accessed via mobile phones or computers anywhere and anytime on the internet network (Ampa, 2015). The preparation of the framework includes the creation of a storyboard and the design of the

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menu function. The storyboard design describes the appearance of the e-encyclopedia that will be developed and its contents. Furthermore, drafting is done by compiling the material content that will be displayed in the e-encyclopedia in detail. The display of the mangrove ecosystem e-encyclopedia product is shown in Figure 2.

Figure 2. View of The Mangrove Ecosystem E-encyclopedia

Product Quality

The results of the initial product development in the form of an e-encyclopedia of the mangrove ecosystem were further validated by media expert lecturers and material experts. The results of media expert validation are in Table 12.

Table 12. Media Expert Validation Results

Numb.	Aspect	Maximum Score	Assessment Result	
			Validator 1	Validator 2
1.	Graphic	14	14	14
2.	Instructional component	4	4	4
	Total	18	18	18
	Mean		18	
	Category		Very Suitable	

Based on Table 12, the two validators were assessed with a maximum score of 18, so the quality of the mangrove ecosystem e-encyclopedia is very suitable for use as a learning resource in science learning. Media experts provided several inputs, including changing the background color to green, looking for more proportional images, and changing the font size to make it more transparent. In contrast, the results of the assessment of material expert lecturers are in Table 13.

Table 12. Material Experts Validation Result

Numb.		Aspect	Maximum Score	Assessment Result	
				Validator 1	Validator 2
	1	Content eligibility components	11	11	11
	2	Serving components	6	6	6
	3	Linguistic component	5	5	5
Total			22	22	22
		Mean		22	
		Category		Very Suitable	

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Based on Table 13, the two validators were assessed with a maximum score of 22, so the quality of the mangrove ecosystem e-encyclopedia material is very suitable for use as a learning resource. Material experts also provide input to add material on examples of mangroves in Indonesia and improve sentence structure.

Two science teachers carried out the practicality assessment at the school. The results of the science teacher assessment can be seen in Table 14.

Table 14. Practicality Test Results by Science Teachers

Numb.	Aspect	Maximum Score	Assessment Result	
			Teacher 1	Teacher 2
1.	Content eligibility components	11	11	11
2.	Serving components	6	6	6
3.	Linguistic component	5	5	5
4.	Graphic component	14	13	14
5.	Instructional components	4	4	4
Total		40	39	40
	Mean		39,50	
	Category		Very Suitable	

Based on the table above, the average score of the practicality assessment of the e-encyclopedia of mangrove ecosystems is 39.50. It shows that the product is very feasible to be used as a source of student learning references. The science teacher also suggested that the text be enlarged so that it is clearer to read.

The mangrove ecosystem e-encyclopedia product has passed the validation process and was revised twice based on input from media, material, and science teachers. The details of the material contained in the e-encyclopedia include the understanding of mangrove ecosystems, characteristics, flora and fauna, energy flow, conditions of mangrove ecosystems in Indonesia, and efforts to overcome damage to mangrove ecosystems in Indonesia. The e-encyclopedia product for mangrove ecosystems is developed based on a website accessed at www.ensiklopediamangrove.id. The theme in the e-encyclopedia of mangrove ecosystems is associated with science learning materials in KD 3.7 regarding the interaction of living things and the environment.

Limited Trial

The results of the revised e-encyclopedia of mangrove ecosystem products based on input from media experts, material experts, and science teachers were then carried out with limited trials. This test aims to obtain student readability responses to the developed product. The subjects of the little practice consisted of 15 seventh-grade students at the school. Students are allowed to access and study the entire material content contained in the e-encyclopedia of the mangrove ecosystem. Next, students fill out a product readability questionnaire distributed online via a Google form. Students can also write input through the questionnaire as material for improving the e-encyclopedia. The results of student responses to the e-encyclopedia are shown in Table 15.

Table 15. Readability Test Results by Students

Numb.	Aspect	Maximum Score	Mean
1.	Content eligibility components	4	3,91
2.	Serving components	6	5,73
3.	Linguistic component	2	1,82
Total		12	11,45
	Category		Very Suitable

Based on Table 15, the results of the student's assessment of the mangrove ecosystem e-encyclopedia product are feasible. It is indicated by the average score of 11.45.

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Effectivity

Mangrove ecosystem e-encyclopedia products declared feasible and tested on a limited basis are then implemented in field trials. The field trial aims to determine the effectiveness of using the e-encyclopedia of mangrove ecosystems to improve students' information literacy skills and environmental care attitudes. The product's effectiveness can be seen based on the results, the student's pretest and posttest gain scores, the Manova test results, and the size effect.

Students' information literacy skills were measured by giving written pretest and posttest questions to the control and experimental classes. The content of the written test questions contains indicators of student information literacy, which consists of problem formulation, information-seeking strategies, allocation and access, information utilization, information synthesis, and evaluation of data. The measurement results are shown in Table 16.

Table 16. Results of Measurement of Information Literacy Skills

Class	Assessment Result		N gain	Category
	Pretest	Posttest		
Control	67, 74	71,55	0, 12	Low
Experimental	70, 77	80,22	0, 32	Currently

Table 16 shows that the average value of information literacy skills in the control and experimental classes has increased. The results of the analysis of the gain score $<g>$ in the control class are 0.12, so it is included in the low category, while the score $<g>$ in the experimental class is 0.32, so it is included in the medium category. The $<g>$ score in the experimental class was higher than the $<g>$ score in the control class. The difference in score $<g>$ is due to different learning resources. The experimental class used the e-encyclopedia of the mangrove ecosystem, while the control class used books from the power point-assisted service. These differences indicate how using the mangrove ecosystem e-encyclopedia improves students' information literacy skills.

Students' environmental care attitudes were measured using pretest and posttest questionnaires in the control and experimental classes. The questionnaire's content includes indicators of environmental care attitudes, which have behavior to maintain cleanliness, attitudes towards energy, attitudes towards the homeland and air, attitudes towards flora and fauna, including mangrove ecosystems, and attitudes towards humans and the social environment. The results of measuring students' environmental care attitudes are shown in Table 17.

Table 17. Results of Measurement of Students' Environmental Care Attitude

Class	Assessment Score		Gain Skor	Category
	Pretest	Posttest		
Control	85, 98	88, 42	0, 17	Low
Experimental	84, 71	87, 33	0, 17	Low

Based on Table 17, the pretest value of the control class is 85.98, while the experimental class is 84.71. However, the posttest score in the experimental class was higher than the posttest score for the control class, which was 87.33. The $<g>$ score in the control class was the same as the experimental class, which was 0.17. The $<g>$ score between the two classes was the same despite using different learning resources. It could be because the students took part in learning and filled out questionnaires quickly. There had been no significant changes related to the attitude of caring for the environment.

Measurement with a score of $<g>$ has shown the effectiveness of e-encyclopedias, especially on students' information literacy skills. Furthermore, it is necessary to simultaneously carry out the Manova test to determine the difference in the average increase in information literacy skills and environmental care attitudes in the control and experimental classes. The Manova test also answers the hypothesis:
H0: There is no significant difference between control and experimental class students' information literacy skills (Y1) and students' environmental care attitudes (Y2).
H1: There is a significant difference in information literacy skills (Y1) and students' environmental care attitudes (Y2) between students in the control and experimental classes.

The Manova test can be carried out if the data used meets the Manova prerequisite test. The results of the Manova prerequisite test include: 1) The independent variable data is interval data; 2) There are

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two or more independent variables; 3) Observations are independent; 4) The number of samples have met, which consists of 52 students; 5) There is no outlier data; 6) All data are typically distributed; 7) Data is linear; 8) The data are homogeneous, and 9) There is no data multicollinearity. All prerequisite tests of Manova have been met so that the Manova test can be carried out. The results of the Manova test are in Table 18.

Table 18. Manova Test Results

Test Name	Value	F	Sig
Pillai's Trace	0, 180	3, 292	0,004
Wilks' Lambda	0, 824	3, 353	0,004
Hotelling's Trace	0, 209	3, 412	0,003
Roy's Largest Root	0, 184	6, 123	0,001

The results of the Manova test in Table 18 show that the significance value of Pillai's Trace is 0.004, Wilks' Lambda is 0.004, Hotelling's Trace is 0.003, and Roy's Largest Root is 0.001. All significance values are less than 0.05. Based on the results of this test, it can be concluded that there is a significant difference in improving students' information literacy skills and environmental care attitudes. It shows that the use of e-encyclopedia of mangrove ecosystems effectively increases students' information literacy and environmental care attitudes compared to other learning resources commonly used in schools.

The differences in information literacy skills and environmental care attitudes of students in control and experimental classes indicate that the ecosystem e-encyclopedia affects these two variables. The results of the Manova test are simultaneous on the variables of information literacy skills and students' environmental care attitudes. The effect of using the e-encyclopedia of mangrove ecosystems on each variable can be determined by using effect size analysis. The results of the effect size analysis on the variables of information literacy skills and environmental care attitudes are shown in Table 19.

Table 19. Effect Size Analysis Results

Variable	Partial Eta Squared
Information Literacy	0, 148
Environmental Care Attitude	0, 029

Based on Table 19, the effect size value on the variable information literacy skills is 0.148, which is included in the large category. The effect size value on the environmental care attitude variable is 0.029, included in the small category.

The preliminary study shows the students' need for engaging learning media and can increase students' insight. The developed media can be used as a reference source for science learning. Reference sources function as books that can complement the deepening of material and add insight for readers from discussing material not fully presented in textbooks (Astra, 2018; Maulana, 2018). Reference sources can add insight into students and develop students' attitudes and psychomotor aspects (Asrizal, 2020). Website-based media also provides an alternative for online learning during the Covid-19 pandemic, where students cannot access manual learning resources at school. The website provides special facilities to accommodate various data types in text, voice, video, and others (Scott, 2012).

The results of data analysis indicate that developing an e-encyclopedia of mangrove ecosystems can train students to be skilled in information literacy. E-encyclopedias can present information in a complex, interactive, and fun way. Students skilled in information literacy can identify information, determine needs, search for information, access and allocate information, use data, combine data, communicate information, and assess results and processes. Information literacy skills are essential to learning (Riski, 2018). Students are cognitively intelligent, and their skills or skills are well-trained (Abrori, 2018).

Developing an e-encyclopedia of mangrove ecosystems is a solution to overcome environmental problems, especially those related to the damage to mangrove ecosystems in Indonesia. In this context, the more comprehensive students' knowledge, the more sensitive they are to the surrounding environment. Efforts to preserve mangrove ecosystem areas can be carried out by educating the public about the existence and benefits of the ecosystem (Tanjung, 2017). Students' environmental care attitude can be improved by providing knowledge about the problems that exist in the surrounding environment

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(Nasution, 2016). Education plays a role in forming one's abilities, personality, and character. Attitude change is a tangible form of the success of the learning process implemented (Zeidan, 2014).

The analysis of gain scores and effect size on the environmental care attitude variable shows that the level of influence is in a small category. The low impact of e-encyclopedias on environmental care attitudes can be caused by the brief time of filling out pretest and posttest questionnaires. It has not shown a significant change in attitude. Online learning during the Covid-19 pandemic caused some students to be late reading the information presented in class groups, resulting in delays in completing questionnaires. Some new students fill in after getting the material at the first meeting. Teachers need to contact students one by one to ensure students have filled out the questionnaire that has been distributed. This condition is a challenge for teachers to carry out online learning while still accommodating learning objectives, especially in attitude (Santika, 2020).

The mangrove ecosystem e-encyclopedia product is disseminated by distributing the website address to science teachers and students. Teachers can use the website in the learning process directly or online. E-encyclopedia products can also be used to improve science learning objectives more broadly. In addition, mangrove ecosystem materials can support related science learning materials.

CONCLUSION

Based on the results of research and discussion, it can be concluded that e-encyclopedia is included in the very feasible category based on the results of the assessments of material experts and media experts, science teachers, and students. The results of data analysis also show that the e-encyclopedia of mangrove ecosystems is also effective for improving students' information literacy skills in the high category and environmental care attitudes in the small category.

BIBLIOGRAPHY

Abrori. (2018). Improving Reading Literacy Strategy through Seven Programs of Reading Interest containing Da ' wah Message. *Attarbiyah: Journal of Islamic Culture and Education*, *3*(2), 205–225. https://doi.org/10.18326/attarbiyah.v3i2.205-225

Ampa, A. T. (2015). The Implementation of Interactive Multimedia Learning Materials in Teaching Listening Skills. *English Language Teaching*, *8*(12), 56. https://doi.org/10.5539/elt.v8n12p56

Asrizal, Desnita, & Darvina, Y. (2020). Need analysis to develop an electronic enrichment book of Physics based on contextual teaching and environmental potential. *Journal of Physics: Conference Series*, *1481*(1). https://doi.org/10.1088/1742-6596/1481/1/012123

Astra, I. M., & Saputra, F. (2018). The Development of a Physics Knowledge Enrichment Book, "Optical Instrument Equipped with Augmented Reality," to Improve Students' Learning Outcomes. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/1013/1/012064

Gyaase, P. O., Anokye-sarfo, A., & Bediako, Y. (2013). The Adoption Of Information And Communication Technology In The Public Sector; A Study Of The Financial Management In The Ghana Education Service (GES). *International Journal of Scientific & Technology Research*, *2*(12), 327–335.

Harun, R., Hock, L. K., & Othman, F. (2011). Environmental knowledge and attitude among students in Sabah. *World Applied Sciences Journal*, *14*(SPL ISS 1), 83–87.

Istiqomah, I. (2019). Sikap Peduli Lingkungan Peserta Didik di MAN-1 Pekanbaru Sebagai Sekolah Adiwiyata. *Dinamika Lingkungan Indonesia*, *6*(2), 95. https://doi.org/10.31258/dli.6.2.p.95-103

Kahar, A. P. (2018). Application of mangrove ecosystem material based on the local potential to improve students' environmental awareness attitude. *Didaktika Biologi: Jurnal Penelitian Pendidikan Biologi*, *2*(1), 1–8.

Maulana, S., Desnita, D., & Raihanati, R. (2018). The Development of Knowledge Enrichment Books Concerning Ice and Snow Physical Studies for High-School Students. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *4*(2), 83–90. https://doi.org/10.21009/1.04205

ISSN 2406-9205 (print), ISSN 2477-4820 (online)

Nasution, R. (2016). Analisis Kemampuan Literasi Lingkungan Siswa SMA Kelas X di Samboja dalam Pembelajaran Biologi. *Proceeding Biology Education Conference*, *13*(1), 352–358. https://jurnal.uns.ac.id/prosbi/article/view/5746

Prasetyawan, Y. Y. (2018). Pengembangan Instrumen Pengukuran Kemampuan Literasi Informasi Berbasis Efikasi Diri (Self Efficacy). *Anuva*, *2*(3), 273. https://doi.org/10.14710/anuva.2.3.273-279

Riski, L., Winoto, Y., & Rohman, A. S. (2018). Literasi Informasi Siswa Sekolah Menengah Pertama dalam Pengerjaan Tugas Sekolah. *BIBLIOTIKA : Jurnal Kajian Perpustakaan Dan Informasi*, *2*(2), 132–140. https://doi.org/10.17977/um008v2i22018p132

Santika, I. W. E. (2020). Pendidikan Karakter pada Pembelajaran Daring. *Indonesian Values and Character Education Journal*, *3*(1), 8–19.

Scott, D., Cheong, M., & Li, H. (2012). Web-based Construction Information Management System. *Construction Economics and Building*, *3*(1), 43–52. https://doi.org/10.5130/ajceb.v3i1.2910

Supriadi, S. (2017). Pemanfaatan Sumber Belajar Dalam Proses Pembelajaran. *Lantanida Journal*, *3*(2), 127. https://doi.org/10.22373/lj.v3i2.1654

Tanjung, R., Khakhim, N., & Rustadi, R. (2017). Kajian Fisik Pesisir Kulon Progo untuk Penentuan Zona Kawasan Mangrove dan Tambak Udang. *Majalah Geografi Indonesia*, *31*(2), 22. https://doi.org/10.22146/mgi.26320

Wismarini, T. D., Budi, D., & Ningsih, D. H. U. (2012). Elektronik Ensiklopedi Tanaman Herba sebagai Bank Data Digital Tanaman Obat. *Jurnal Teknologi Informasi DINAMIK*, *17*(2), 90–97.

Zeidan, A. H., & Jayosi, M. R. (2014). Science Process Skills and Attitudes toward Science among Palestinian Secondary School Students. *World Journal of Education*, *5*(1), 13–24. https://doi.org/10.5430/wje.v5n1p13

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