



Designing e-modules on mangrove species diversity leveraging local potential through pbl to foster environmental attitudes

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ABSTRACT

This study aims to develop e-modules of mangrove species diversity as local potential in learning. The development model used is the Lee & Owens (2004) development model. There are five phases in the development of research, namely the analysis, design, development, implementation and evaluation. The used learning model is Problem-Based Learning by presenting authentic mangrove problems in Banten. The e-module that has been developed will be tested for validity, practicality and effectiveness so that it can be disseminated for student learning activities. E-modules are tested for validity by conducting a 100% material expert validation test, 98.77% media and teaching material validation results and 100% validation results from field practitioners. Before being used in learning, the e-module was tested for practicality with a one-on-one trial getting a score of 93.33%, a small group trial of 89.41%, a field trial of 86.2% and a field test of 95.04%. Based on the results of student response testing, it can be concluded that the e-module of mangrove diversity is practically used in learning. The results of effectiveness testing to see the improvement of students' environmental attitudes were analyzed. The results of effectiveness testing to see an increase in students' environmental attitudes are measured qualitatively with an N-Gain measurement of 0,46 which is included in medium effectiveness and quantitatively measured using a simple paired t test with p-value of 1.88 which means there is a significant difference before and after using e-module in learning.

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INTRODUCTION

Learning Immaculately integrates digital technology as support (Harun, 2021) preceptors and scholars need to use literacy platforms that can ease access and monitoring by parents (Astuti & Harun, 2020). Digital media has benefits that make it easier for scholars to learn the material presented. Some motifs in biology subjects cannot be imaged directly so they need learning media (Jayawardana, 2017). Mangrove conservation efforts are made by presenting mangrove species material into electronic modules to attract students' interest in learning by adjusting the times (Janna et al., 2020). The problem of learning the diversity of living effects in seminaries is the material in pupil handbooks that doesn't contain original eventuality, especially to introduce biodiversity in Indonesia (Lestari et al., 2021). preceptors have now done exploration on biodiversity to support literacy (Novy et al., 2015). Original implicit requirements are to be introduced as trouble to enrich literacy coffers for scholars. It's necessary to explore biodiversity by conforming to the class, structure and academy readiness in enforcing original eventuality in literacy (Pratiwi et al., 2019). According to the results of (Etika et al., 2024) the study stated that bringing Learning that combines images, videos and text by utilizing digital technology in the development of local potential can improve attitudes towards environmental protection and mangrove ecosystems that will be integrated according to the chapter on the diversity of living things in schools. Students' environmental attitudes can be trained if learning integrates local potential in learning so that students gain new knowledge about the local potential of their area, the problems of the diversity of living things in the surrounding environment, and formulate solutions to what steps can be taken to make conservation efforts wisely (Rosidi et al., 2023).

The significance of developing literacy media that supports the material of the diversity of living effects grounded on original eventuality. Original implicit literacy is exercising all original knowledge to be integrated into the material in agreement with literacy objects (Pornpimon et al., 2014). Learning with original eventuality is demanded to attract scholars' interest in learning conditioning. It's anticipated that scholars are suitable to know the eventuality of their region and fete the environmental problems that do (Masub et al., 2016). The thing is that scholars can save original eventuality and find results to overcome environmental problems (Pornpimon et al., 2014; Trisianawati et al., 2019). The capability of scholars to fete and suppose about environmental problems is called environmental station (Wahyuningsih et al., 2021). The purpose of environmental stations is to train and shape scholars to have a station to save nature. Environmental education in literacy can develop environmental stations whose purpose is to motivate to make a wise decision and consider environmental aspects (Ugulu et al., 2013).

Development of the original eventuality to train scholars' environmental stations, mangroves can be appointed as tutoring accouterments for the diversity of living effects in seminaries. Mangroves have a major part, videlicet the largest carbon insulation compared to tropical rainforests (Jachowski et al., 2013). One problem is to introduce the significance of mangroves to scholars by studying mangroves to be used as tutoring accouterments grounded on original eventuality to support biology literacy (Lestari & Irawati, 2020). It's hoped that scholars' knowledge about mangroves can increase, know their part and can make conservation sweats (Aprilia & Suryadarma, 2020; Purwanti et al., 2020).

The characteristics of literacy that can spark scholars to suppose are by looking at a problem that can be related to everyday life (Amin et al., 2020). The right model used in learning the diversity of living effects is Problem-Based Learning (PBL). PBL is a literacy model that raises real and contextual problems for scholars to probe and find the right result. PBL can train problem-solving chops grounded on authentic case studies given (Bahri et al., 2018). The employment of the PBL model requires scholars to be able to break problems to train communication and collaboration in the division of tasks between scholars (Arends, 2012). Grounded on the explanation over, it's necessary to develop an e-module of mangrove diversity grounded on original eventuality using the PBL model to train environmental attitude. PBL trains students to be able to think critically about existing problems and shapes students to think about how to solve these problems so as to cause changes in student attitudes regarding environmental problems (Mustaqimah et al., 2020).

METHODS

Research Design

This research is a research and development that produces products in the form of e-module media (Amali et al., 2019). The research and development model used is from Lee and Owen. There are

five stages in the development of research including the analysis stage, design stage, development stage, implementation stage and evaluation stage (Lee & Owens, 2004) The research stages were carried out by exploring the diversity of mangrove species in the Pulau Dua Nature Reserve, Serang Banten, Indonesia. The results of mangrove diversity research will be developed in an e-module that is used for learning the diversity of living things in class X SMAN 5 Serang City, Indonesia. Before the e-module can be used in learning, a validation test is carried out by material experts, media experts teaching materials and biological education practitioners to assess the extent of the validity of the products produced. The next stage is the practicality test of one trial conducted by 3 students, a small group trial conducted by 12 students, and a pilot test conducted by 36 students. Based on suggestions and revisions from student responses, it will illustrate that the developed product is practical to use in learning. The next stage is to test the effectiveness of using the e-module to assess whether or not there is an increase in students' environmental attitudes. The indicators used in measuring students' environmental attitudes refer to Milfont & Duckitt (2010) with 12 indicators of environmental attitudes invented.

Population and Samples

The population used in this development research is all students of SMAN 5 Serang City, Indonesia. The sample used is for testing one trial 3 students from class XII 1, a small group trial of 12 students from class XII IPA 2, conducting a pilot test of 36 students of class X-7 and the implementation class in this study is X-3 totaling 50 students.

Instrument

The data collection techniques used were teacher and student interview questionnaires in the needs analysis as a preliminary study. The validation assessment sheet to material experts, media experts teaching materials biology education practitioners, practitioner sheets based on student responses and PBL syntax implementation sheets. The instrument used to measure students' environmental attitudes is a questionnaire containing positive and negative statements that refer to the 12 indicators of the environmental attitudes inventory according to Milfont & Duckitt (2010). The results of the study will be analyzed by paired t-test.

Procedure

Research and development procedures through the Lee & Owens (2004) research model, namely analysis, design, multimedia development, implementation and evaluation. In the analysis stage the researcher conducted a preliminary study by conducting a needs analysis of teachers and students, in the design stage the researcher conducted a design related to the design and layout of the e-module, in the development stage the researcher conducted pure research by conducting a survey of mangrove diversity in the Pulau Dua Nature Reserve Serang, Banten, Indonesia. The initial stage that needs to be done is to make a Conservation Area Entry Permit to West Java BKSDA Region 1 Serang, Indonesia. The results of the exploration of mangrove diversity in the Pulau Dua Nature Reserve Serang Banten, Indonesia will be used as content on the e-module. The preparation and development of the e-module were carried out with validation testing by material experts, media experts teaching materials and biological education practitioners. The next stage is effectiveness testing using a simple paired t-test and N-Gain Score on the environmental attitude questionnaire.

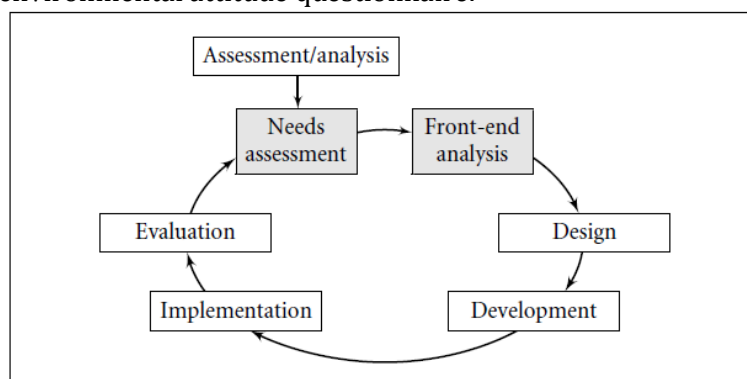


Figure 1. Lee & Owen's development model (2004)

Data Analysis Techniques

There are two types of data collected from the development and implementation stages, namely qualitative data and quantitative data. Qualitative data is obtained from the distribution of questionnaires to determine the validity and practicality of e-modules, and the implementation of learning syntax while quantitative data is obtained from the results of the e-module effectiveness test developed.

1) Validity and Practicality of e-module

The data obtained from the validation and practicality of the e-module are presented using a Likert scale, then analyzed descriptively in percentage form and adjusted to the validity and practicality criteria according to Akbar (2013). The formula used is as follows.

$$v = \frac{TSe}{TSh} \times 100$$

Description:

V : Percentage of e-module validity

TSe : Total validator assessment score

TSh : Total maximum score

The results of the validity calculation will be measured against the criteria in [Table 1](#).

Table 1.

Validity Measurement

Score (%)	Criteria	Description
100	Very Valid / Very Practical	E-module is used without revision
81- 99	Very Practical	E-module is used with minor revisions
61- 80	Practical	E-module is used with moderate revision
41- 60	Less Valid	less practical E-module is not recommended for use because it needs major revisions
21- 40	Not Practical	E-module cannot be used
0 - 20	Not Very impractical	E-module cannot be used

Adaption: Akbar (2013)

Description: Material validity criteria must be 100%

2) Implement ability of PBL Learning Syntax

Data on the implementation of PBL syntax was obtained from the learning implementation sheet that had been filled in based on observations by observers. The percentage of learning syntax implementation is calculated using the formula:

$$P = \frac{A}{B} \times 100$$

Description:

P : Percentage of learning implementation

A : Total number of scores obtained

B : Total ideal score

The percentage value is then matched with the learning implementation criteria in [Table 2](#).

Table 2.

Criteria for Implementation of Learning Syntax

Score (%)	Description
85.01- 100	very good
70.01- 85.00	good
50.01- 70.00	enough
40.01- 50.00	Not good
25.00- 40.00	very poor

Adaption: Akbar (2013)

3) Effectiveness of E-module

The e-module effectiveness test is obtained from the pretest and posttest results of environmental attitudes measured using the N-gain score formula. The N-gain score test is a test that

can provide an overview of the increase in pretest and posttest results. The effectiveness of the e-module can be calculated with the N-Gain test. Based on the results of the effectiveness of the e-module with the N-Gain formula, it will be interpreted qualitatively.

RESULTS AND DISCUSSION

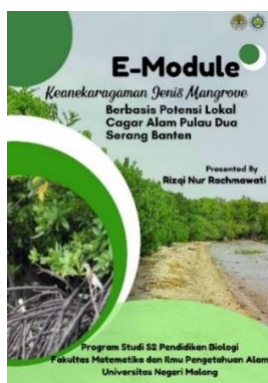
The results of the analysis stage of the Lee & Owens (2004) development model is obtained from the preliminary study, namely the needs analysis of teachers and students who stated that the teacher had never explored biodiversity as a learning resource. Learning that is done is still limited to memorizing material that is not linked to phenomena that occur in the environment to form students' environmental attitudes. Based on the results of the needs analysis, the researchers explored the mangrove of Pulau Dua Nature Reserve in Serang, Banten Indonesia to be used as learning content on the material of the diversity of living things. The results of the e-module development were tested for validation of materials, media and teaching materials as well as biology education practitioners. Based on the development stages of the Lee and Owen (2004) model, there are 5 steps, namely:

1. Analyze

Based on the results of the needs analysis, students have difficulty learning the material of Diversity of Living Things because the material is complex. Learning activities are still in the form of memorization and have not introduced contextual examples that exist in the student's environment. Biology teachers have not utilized the local mangrove potential of the Pulau Dua Nature Reserve in learning. Mangroves have an important role in the ecosystem that students need to know and have the potential to be used as learning content. Students need to be introduced to the potential of their region to recognize the advantages and biodiversity around them so that they can be wise in carrying out activities by considering environmental aspects.

2. Design

At this stage, the researcher develops an e-module that integrates environmental attitude indicators according to Milfont and Duckitt (2010) which are integrated with the Learning Outcomes in the Merdeka Curriculum in the class X Diversity of Living Things chapter. The environmental attitude questionnaire is designed by providing positive and negative statements by the indicators to ensure students' answers are appropriate. The questionnaire consists of 38 statement items that have been validated by learning device experts and have been tested for validity and reliability so that they are suitable for use. The following is an e-module design display of mangrove species diversity that has been integrated with environmental attitudes in PBL learning in Figure 2.



(a)



(b)



(c)



Figure 2. (a) cover, (b) instructions for use, (c) list of menus in the e-module, (d) material menu, (e) LKPD menu, (f) concept map, (g) LKPD integrated with environmental attitudes, (h) equipped with QR code mangrove identification book, (i) glossary.

3. Development

a. Pre-Production

E-module of mangrove species diversity is developed based on the storyboard that has been made.

b. Production

1. Pure Research Results

The content in the e-module was developed based on the results of the exploration of mangrove diversity in the Pulau Dua Nature Reserve, Serang, Banten. Research on mangrove diversity in Pulau Dua Nature Reserve Serang, Banten, Indonesia.

2. Abiotic Factors of Mangrove Area of Serang, Banten Nature Reserve

Abiotic factors observed based on this research are temperature, air humidity, light intensity, soil moisture, soil pH and salinity levels. Abiotic factors can be a marker of the range of tolerance of mangrove growth at that location.

3. Post-Production and Quality Review

The stages of developing teaching materials in the form of e-modules include the process of designing e-module media and then conducting trials to determine the validity and practicality of e-modules by experts. The results of research and development in the form of teaching materials in the form of e-modules of mangrove species diversity Pulau Dua Nature Reserve Serang, Banten, Indonesia. This e-module will be used in Biology class X at SMAN 5 Serang, City. The results of mangrove diversity will be used as content on e-modules used as learning media for students. E-modules that have been developed before being disseminated to students are validated by material experts. Material validation is carried out to assess and evaluate the feasibility of content before use. The purpose of material expert validation is to assess the content and presentation of enrichment materials based on the variables measured (Salsabilla et al., 2023). The aspects assessed from the media validation sheet and teaching materials are the feasibility of cover graphics, the feasibility of content graphics, e-module

characteristics (self-instruction, self-contained, stand-alone, adaptive, user friendly) the closing section and access to the use of e-modules (Ruslan & Rauddin, 2022). The following are the results of expert validation of the e-module of mangrove species diversity. The results of validation conducted by experts can be seen in Figure 3.

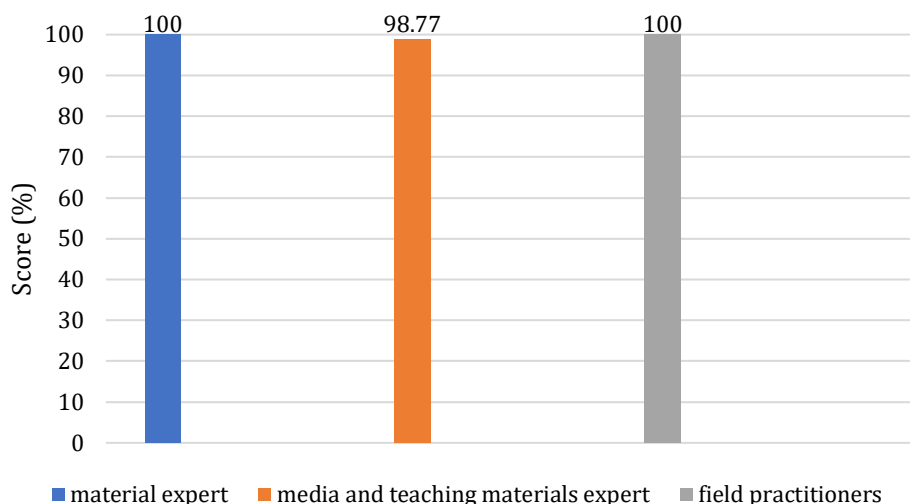


Figure 3. Results of E-module Validation

Based on the results of the material expert validation, the aspects assessed include the organization of the material, the depth of the material (identification of mangroves based on characteristics, analysis of mangrove diversity groupings, interactions between biotic and abiotic components, the role of mangroves as local potential, analysis of various threats to sustainability and alternative mangrove conservation efforts). The material assessed by the validator must be 100% so that if it has not reached it needs to be revised several times. This is done so that the material is truly valid and no misconceptions occur, so that it can be used in learning. The results of mangrove diversity will be used as content on the E-module utilized as content on learning media for students. E-module that has been developed before being disseminated to students conducted validation stage by material experts. Material validation is carried out to assess and evaluate the suitability of the material before use. The purpose of material expert validation is to assess the content and presentation of enrichment material based on the variables measured (Salsabilla et al., 2023). The validation of this e-module material a lecturer from Mulawarman University. Material expert validation must reach a score of 100% to prevent the material presented from being double or even misconceptual (Rahmawati & Trimulyono, 2021).

Media expert validators assessed the e-module of mangrove species diversity developed with the validation sheet guide (Hadi & Dazrullisa, 2018). The aspects assessed from the media validation sheet and teaching materials are the feasibility of cover graphics, the feasibility of content graphics, e-module characteristics (self-instruction, self-contained, stand-alone, adaptive, user friendly) the cover and access to the use of e-modules (Ruslan & Rauddin, 2022).

The validity study of media and teaching materials was carried out by media experts a lecturer in Learning Technology at the State University of Malang. The e-module validation sheet used refers to the Ministry of Education and Culture (2017: 23). The results of media and teaching material expert validation before revision were 96.65% while after revision were 98.77% which were included in the category of very valid for use in learning. E-modules are equipped with images, barcodes, videos and various links that make it easier for students to learn material that was originally abstract to be simpler and easier to understand (Raquzitya et al., 2022).

The assessment by media experts who have the lowest score is on the aspect of covering grammatical feasibility. An attractive cover will give the impression of enthusiasm to learn for students (Handayani et al., 2020). The highest score on the assessment of media and teaching materials experts is on the characteristics of the e-module. The characteristics of the e-module must appear as a differentiator from other teaching materials. The goal is that the e-module can be used independently (Kristina et al., 2022).

The selection of colors, layout or placement of text, images, audio, video and animation as well as the consistency of buttons as a display of learning media is important (Mukti & Nurcahyo, 2017). Based on this, the display in the e-module of mangrove species diversity is arranged simply so that it is easy for students to use (Tasyari et al., 2021). The use of appropriate and contextual learning media can provide motivation for students to learn (Athiyah, 2018) so that students will be more enthusiastic about studying the mangroves of the Pulau Dua Nature Reserve as the local potential of their area which is integrated into the concept of Diversity of Living Things at school.

The field practitioner assessment is Biology teacher of SMAN 5 Serang City, Indonesia. The indicators tested were completeness of the content, e-module characteristics, language, presentation, material, graphics and PBL syntax. The results of practitioners before revision were 96.90% while the results after revision were 100% which fell into the very practical category. Thus, the e-module of mangrove diversity based on the local potential of the Pulau Dua Nature Reserve is very practical to use in learning. According to Akbar (2013) practicality with a score of 100% indicates that the media developed is applies to both teachers and students (Sarip et al., 2022).

The assessment indicators in the practicality trial include the completeness of the content (conformity with learning objectives, the benefit of adding insight, the completeness of the opening, content and closing, has illustrations and images that clarify the content), e-module characteristics, language (has clear, communicative readability and the use of terms equipped with a glossary), presentation, systematic material and easy to learn, good graphics in terms of harmonious layout, and PBL learning syntax. Research conducted by Hanifah et al (2020) states that research and development of non-print teaching media can improve biology learning outcomes because students like digital learning. The ease of use of digital technology also has an impact on the shift in the transfer of knowledge in schools, which originally used printed books, now utilizing digital media (Wahyono, 2019). The use of digital media in learning that can be accessed by devices will make it easier for students because access to learning is independent and has no time limit (Nisa et al., 2018). Based on the results of the validity test after revision, the material expert obtained a score of 100%, the validity of the media expert was 98.77%, and the biology education practitioner was 100%. According to Akbar (2013), the score is in the very valid category. Accordingly, the e-module of mangrove species diversity is valid for use in learning.

To see the practicality of the e-module that will be used in learning, a one-to-one trial of 3 students was conducted, a small group trial of 12 students, and a field trial of 36 students. The following is a picture of the acquisition of student responses in Figure 4.

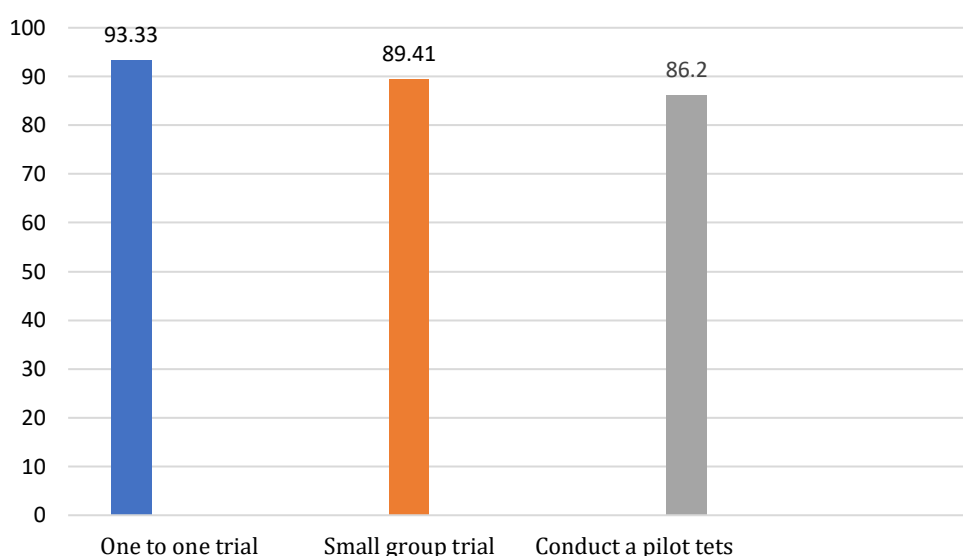


Figure 4. Practicality test results

Based on the results of the practicality test one to one trial 93.33, a small group trial 89.41, conduct a pilot test 86.2. The three student responses showed a very practical category. Based on this, the diversity e-module is practically used in learning. Good media is simple and easy to use in learning

(Surata et al., 2020). Good media is simple and easy to use for students but interesting to use in learning (Ferastia, 2022). There are several suggestions and input given by students, including the cover used should be revised to make it more attractive and add definitions to some biological terms in the glossary. A practical e-module will improve students' understanding of concepts (Hoiroh & Isnawati, 2020). Based on the results of the practicality test, the e-module of mangrove species diversity is very practical to use in learning.

The use of learning media has the aim of motivating to students. The media must also stimulate students to remember what has been learned in addition to providing new learning stimuli. Good media will also activate students in responding, and feedback and also encourage students to do field practice correctly according to the method (Susilo, 2015).

4. Implementation

At the implementation stage what must be prepared is to prepare teachers, students and observers to observe how the learning process with the PBL model can be carried out. During this implementation stage, the teacher will test whether this e-module of mangrove species diversity integrated into the PBL model and Banten's local potential can train students' environmental attitudes.

5. Evaluation

Based on the environmental attitude questionnaire adapted from indicators according to Milfont & Duckitt (2010). There is a significant percentage difference between the pretest and posttest of the students' environmental attitude questionnaire. The following is a comparison picture of Pretest and Posttest environmental attitudes in Figures 5 and 6.

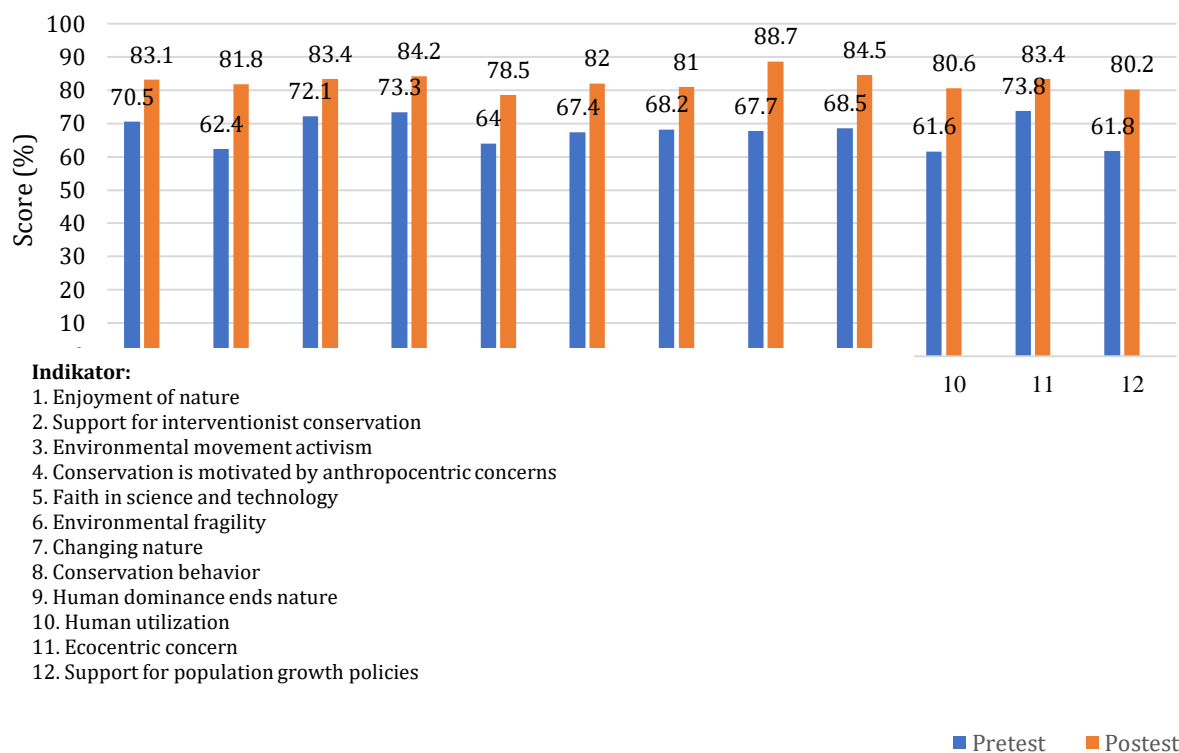


Figure 5. Score Pretest Posttest Each Indikator of Environmental Attitude

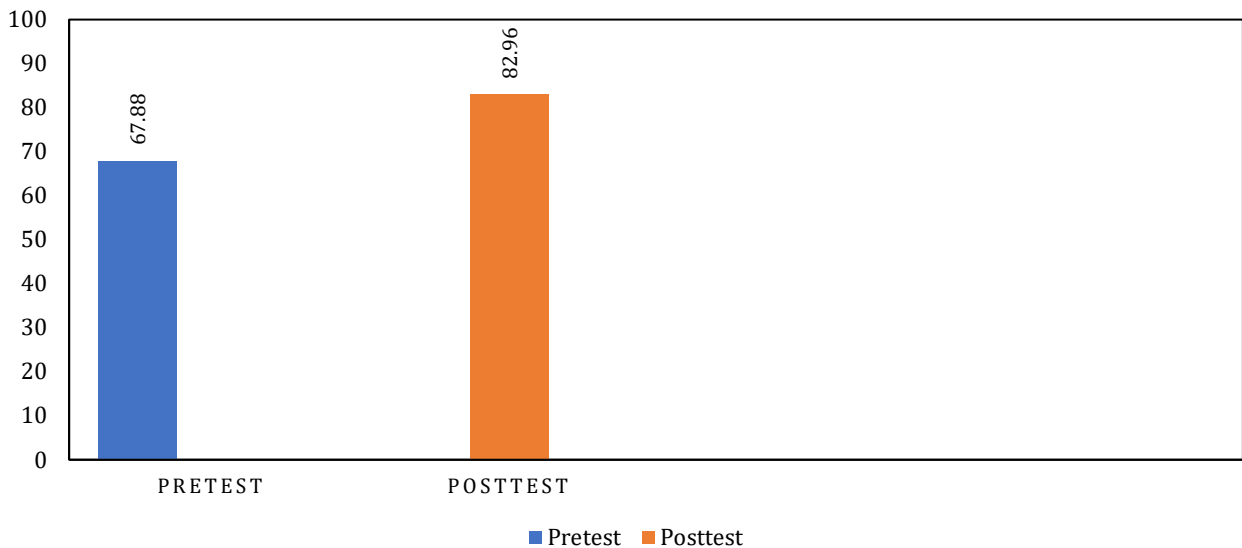


Figure 6. Comparison of Pretest Posttest Score of Environmental Attitude

Based on table 5. The increase in environmental attitudes shows the pretest average of 67.88 increased in the post-test acquisition of 82.96. The increase in value was 22.21%. The indicator that showed the highest increase was the support for conservation indicator with a percentage of 31.1% and the lowest indicator increase was the ecocentric attention indicator of 13%. The indicator that experienced the highest increase from pretest to posttest was support for conservation, which increased by 31.1%. The increase in value is because during learning students are asked to show support for conservation in mangrove ecosystems by making posters of conservation efforts. The lowest score increase was the enjoyment of nature indicator, which was 12.6. Environmental attitudes are low in schools because they are not built into the learning curriculum. One example of the low environmental attitudes of students is that many students still litter (Qodriyanti et al., 2022).

Learning should direct students to have high enthusiasm for environmental conservation with a PBL model that is integrated with environmental attitudes. Indicators of conservation behavior in learning activities are reflected by students pouring various conservation ideas conveyed through posters. During learning activities using PBL integrated with environmental attitude indicators include enjoyment of nature, support for interventionist conservation, conservation environmental movement activism motivated by anthropocentric concern, belief in science and technology, environmental fragility, changing nature, conservation behavior, human dominance ends nature, utilization by humans, ecocentric concern and support for population growth policies (Milfont & Duckitt, 2010).

The mangrove diversity e-module was tested for its effectiveness in improving students' environmental attitudes. Indicators used in measuring environmental attitudes refer to Milfont & Duckitt (2010). The e-module effectiveness test was compared qualitatively and quantitatively. The qualitative measurement uses the N-Gain Score while the quantitative measurement uses simple paired t-test with the help of SPSS. The following is the N-Gain Score test for students' environmental attitudes in Table 3.

Table 3.
Environmental Attitude N-Gain Results

$S_{pretest}$	$S_{posttest}$	N-Gain	Category
67.88	82.96	0.46	Medium effectiveness

Based on table 3. The N-Gain score of environmental attitudes was obtained 0,46 which indicates that the effectiveness of using e-modules in improving environmental attitudes is medium. Based on the calculation of the N-gain score, the results obtained show that the mangrove diversity e-module trains environmental attitudes with a moderate category. This is because this is the first time SMAN 5 Serang City has integrated to improve environmental attitudes. It needs various efforts that must be improved so that students' environmental attitudes can be formed consistently increase.

According to Wardani (2022), students' environmental attitudes are still lacking because the learning used tends not to be contextualized. Environmental attitudes can arise if the learning curriculum integrates elements of local potential and local content that train students in learning activities (Marziah et al., 2015). Thus, the e-module of mangrove species diversity based on local potential is effectively used to train the environmental attitudes of students in class X-3 at SMAN 5 Serang City. Based on research by Wahyuningsih et al. (2021), it is claimed that the provision of e-modules that present environmental problems can improve students' environmental attitudes. Liu et al. (2020) said that environmental attitudes can be formed characterized by the introduction of knowledge of environmental conditions. The mangrove diversity e-module presents problems and challenges facts of Banten mangrove conditions which aim to sensitize students to environmental problems (Fua et al., 2018). The success of environmental attitude education involves many parties. Not only teachers but the role involves family, social and cultural (Hazami et al., 2015).

Students need to be introduced to the local potential of their region to have good environmental awareness (Syukur et al., 2022). Habituation is needed to train environmental attitudes by introducing local potential, and learning about the threat of preservation so that students can participate to help preserve the environment (Janna et al., 2020). Students are not accustomed to integrating learning by looking at environmental attitude values. The mangrove diversity e-module is expected to be a bridge for students to start sensitizing that the local potential in Banten is abundant enough to be preserved. This is in line with the simple paired t-test in Table 4.

Table 4.

Paired sample t-test of environmental attitude

Variable	Mean	Df	p-value	Decision
Environmental Attitude	-22.600	49	.000	There is a significant difference Significant

Based on measurements with paired sample t-test testing, the p-value is .000 which means <0.05 so it can be concluded that students who are taught using e-modules have significant differences related to initial environmental attitudes before learning by using e-modules. This e-module is integrated to train students' environmental attitudes by presenting phenomena or mangrove problems in Banten so that students are more concerned and participate in nature conservation (Mulyanie & Efendi, 2023). The problem that occurs today is the inability of students to be able to carry out environmental attitudes wisely (Fitriati et al., 2021). E-modules that raise local potential can be a tool for learning with a conservation education frame (Purmadi et al., 2020). Based on research by Muslim et al (2021), it is said that environmental education can be carried out with various efforts, both family education and environmental education that is familiarized at school. The success of practicing environmental attitudes needs to be continuously integrated as a project in learning so that students have the habit of participating in protecting the environment. Knowing the phenomenon of Banten mangroves that are increasingly damaged even though their role in the ecosystem is high will trigger students to participate in mangrove conservation. According to Wardani (2022), students' environmental attitudes are still lacking because the learning used tends not to be contextualized. Environmental attitudes can arise if the learning curriculum integrates elements of local potential and local content that train students in learning activities (Marziah et al., 2015)(Marziah et al., 2015). Thus, the e-module of mangrove species diversity based on local potential is effectively used to train the environmental attitudes of students.

CONCLUSION

E-module of mangrove species diversity based on the local potential of Pulau Dua Nature Reserve can be used in learning. This e-module after a series of tests is valid, practical and effective for learning on the topic of diversity of living things in class X in high school to be able to train students' environmental attitudes. Learning is relevant to use because it uses a PBL model where students are presented with problems to be able to solve problems so it is expected that environmental attitudes can grow.

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