

The Encyclopedia of Flora on Curiak Island to Improve Critical Thinking Skills of Science Education Students

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Abstract: This research aims to produce a flora encyclopedia product on Curiak Island that is suitable for improving critical thinking skills. Type of Educational Design Research (EDR) research using Tessmer formative evaluation design. The formative evaluation used consists of four stages, namely the self-evaluation stage, expert review, one-to-one evaluation, and small group evaluation. Collecting product validation data using an encyclopedia assessment instrument. Data regarding validity is collected through an encyclopedia validation sheet by giving a score of 1, 2, 3, or 4 (1 = not good, 2 = quite good, 3 = good, and 4 = very good). Critical thinking assessment use essay with four indicators. The findings show that the product developed is feasible in terms of material, media and language. The test results show that there is a significant difference in students' critical thinking abilities before and after learning. Apart from that, the analysis indicator in critical thinking skills obtained the highest score in the medium category. These findings illustrate that the effectiveness of product expectations is effective in improving students' critical thinking abilities.

Keywords: Biodiversity; Critical thinking; Curiak island; Encyclopedia

Introduction

Higher education is a form of formal education for students. Higher education is expected to be able to produce people who have knowledge and character. The FKIP Science Education Study Program at Lambung Mangkurat University designed the curriculum by taking into account 8 IKUs. At the implementation level, graduates are expected to have competitive abilities as educators and researchers. Graduates also have the ability to develop applied natural sciences that are in line with the development of wetland environmental studies. The designed curriculum also adapts to current developments. The 21st Century brings fundamental changes to human life that require different breakthroughs in thinking, conceptualizing and executing things (Prayogi, 2020). So that graduates' achievements in the curriculum are of course expected to have 4C skills, namely critical thinking, creative thinking, communication, and collaboration (Prayogi, 2020; Rosnaeni, 2021). These 4C

abilities in the 21st century are provisions for students in the future.

In reality, students' critical thinking abilities are still low. The results of learning observations in biodiversity courses show that students are still focused on memorizing taxonomy to differentiate species. The low critical thinking skills of students are also supported by Amarila et al. (2021) which shows that students have a low category in terms of providing further explanation. In the other hand Wiyoko, (2019) explain that the knowledge of interpretation, evaluation, and inference of students in the low category. In fact, studying biodiversity is not just focused on rote memorization. Biodiversity courses are closely related to the sustainability of natural resources, the environment, cultural sustainability and also human health. Therefore, critical thinking is important in biodiversity courses. Low critical thinking skills can be caused by a lack of motivation to learn, monotonous learning, or lack of habituation in critical thinking (Firmansyah & Rizal, 2019; Maguna et al., 2016).

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Low critical thinking abilities require special actions to improve them. Repairing problems that occur requires time and stages. Kusumah (2019) recommends overcoming students' low critical thinking abilities through learning with a scientific approach. The scientific approach provides opportunities for students to explore broader knowledge using scientific method (Kusumah, 2019). This also allows students to think more critically about a phenomenon, to raise questions about why and obtain answers. Developing critical thinking skills can also be done through presenting reading material. A reference that provides complete basic information about a particular branch of science which is prepared with the aim of attracting more readers. Readings related to biodiversity are encyclopedias (Rice, 2020). The focus of the encyclopedia is related to basic information about science and other knowledge. Encyclopedias can be used as reference material to study knowledge on certain material (Powietrzynska & Tobin, 2015).

Biodiversity courses are closely related to encyclopedias (Fatimah et al., 2023; Rice, 2020). This course requires students to know various species at taxonomic levels. The various types of species presented in the encyclopedia can be specific to a region (Adawiyah et al., 2023). It is hoped that the encyclopedia will add to the body of knowledge that is more real and contextual. contextuality in a learning resource can be taken from a phenomenon in everyday life (Purwasih et al., 2022). The uniqueness of a phenomenon in daily life that a region has and increases welfare is usually known as local potential (Purwasih et al., 2022). Local potential, if utilized as a learning resource, provides a new face to learning (Khairani et al., 2023; Manalu & Suhartini, 2023; Novitha & Suhartini, 2023). One of the local potentials possessed by the province of South Kalimantan is Curiak Island. Curiak Island was formed from the Barito river delta, and is currently home to the Proboscis Bekantan Research Station by the Indonesian Bekantan Friends Foundation (SBI) in the June 2018. On Curiak Island, there is a very diverse flora, so it has the potential to be used as a learning resource as outlined in the Curiak Island Flora Encyclopedia.

The use of Curiak Island as a learning resource in biodiversity courses allows students to recognize various types of species and environments in the Curiak Island area. Students can recognize various natural resources on Curiak Island which are important for the proboscis monkey habitat. The use of local potential-based encyclopedias provides many benefits such as improving learning outcomes, critical thinking skills, independence and so on (Rosnawati & Sunaryati, 2021; Ubaidillah, 2017). Therefore, this research aims to

produce a flora encyclopedia product on Curiak Island that is suitable for improving critical thinking skills.

Method

This encyclopedia development research is a type of Educational Design Research (EDR) research using Tessmer formative evaluation design. The formative evaluation used consists of four stages, namely the self-evaluation stage, expert review, one-to-one evaluation, and small group evaluation. The research stages can be seen in Figure 1.

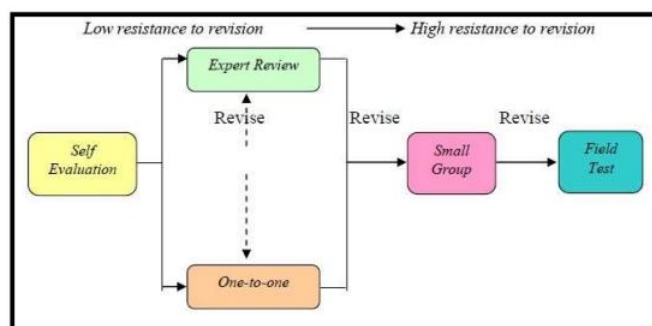


Figure 1. Design formative evaluation

The initial stage begins with product development in the form of draft I, which is then assessed by three experts. The validation results will be used as material for improving the product being developed and producing draft II. Draft II will be tested on 22 students from the science education study program. The course chosen in this research is the biodiversity course using a pretest-posttest control group design.

Collecting product validation data using an encyclopedia assessment instrument. Data regarding validity is collected through an encyclopedia validation sheet by giving a score of 1, 2, 3, or 4 (1 = not good, 2 = quite good, 3 = good, and 4 = very good). Data on the effectiveness of expectations was obtained from student worksheets given on the assessment sheet and based on the student critical thinking skills rubric. The questions given are in the form of essays referring to critical thinking indicators, namely interpretation, analysis, inference and explanation. Validation data were analyzed using the following v-aiken formula:

$$v = \sum \frac{s}{n(c - 1)} \tag{1}$$

Each of these formulas has information, namely v= aiken validity index, s= r-lo, r= lowest validity assessment number, c= highest validity assessment number, and n is the total validators. The Aiken's V coefficient value ranges from 0-1. If the Aiken

coefficient is above 0.5 then the product can be said to be good/adequate. The results of critical thinking skills will be analyzed using a paired sample t-test to show differences in pretest and posttest results. The requirement for carrying out a paired sample t-test is that the data is normal. The basis for making decisions based on the paired t-test results is that if the significant value is > 0.05 then Ho is accepted or Ha is rejected and if the significant value is < 0.05 then Ho is rejected or Ha is accepted. Apart from analysis using statistics, to see the increase in each indicator, an N-Gain analysis is carried out using the following formula:

$$N - Gain = \frac{(Posttest - pretest)}{(100 - pretest)} \quad (2)$$

The calculation results are then categorized based on Table 1.

Table 1. N-Gain Categorized

N-Gain	Category
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Result and Discussion

This research produces a product in the form of an encyclopedia of flora found on Curiak Island. The encyclopedia is used as a learning resource for undergraduate science education students in biodiversity courses. The encyclopedia developed is a collection of flora found on Curiak Island. The first part of the encyclopedia consists of: front cover page, title, foreword, introduction, instructions for using the encyclopedia, table of contents, and concept map. The second part consists of nine discussions, each accompanied by learning indicators. The material contained in part two is discussion 1 about roots, discussion 2 about stems, discussion 3 about leaves, discussion 4 about flowers, discussion 5 about fruit, discussion six about 6 seeds, discussion 7 about the benefits of plants for humans. The final third part consists of: glossary, index, bibliography and author biography. An example of the contents of an encyclopedia is presented in Figure 2.



Figure 2. Example of encyclopedia

This encyclopedia can be a step in recognizing the various flora found on Curiak Island. The next step is to carry out a feasibility test on the content, media and language sections. The results of expert validation of the product material developed are presented in Table 2.

Table 2 shows the validation results of material, media and language experts from three panelists. Obtaining a V aiken coefficient above 0.5 indicates that

the product is in the fit for use category. In this case, the panelists provide an assessment in terms of material, the product has material accuracy. This means that the flora described in the encyclopedia is the flora found on Curiak Island. Meanwhile, if viewed from media validation, the display is rated lower than the others. The encyclopedia displays needs to be improved according to the suggestions given by the panelists (Kartini et al., 2019; Novitha & Suhartini, 2023; Rizki et

al., 2021; Syahfitri & Firman, 2022). The priority of the display is to provide an attractive visualization for the readers so that it can attract and motivate the readers. The language assessment in the encyclopedia shows that the language used is appropriate and easy for readers to understand. Overall with indices that meet the requirements of this product is well developed. Products that have been assessed by panelists and meet the requirements can be used in limited trials (Hardiyansyah et al., 2019; Kartini et al., 2019). A worthy product certainly meets the specified assessment standards (Purwasih et al., 2022; Rosnawati & Sunaryati, 2021).

Table 2. Result of Expert Judgment of Product

Validation	Aspect	V-Aiken	Categorize
Material	Accuracy of Material	0.86	Good
	Activities that support the material	0.79	Good
	Update of Material	0.75	Good
	Material for developing DT abilities	0.75	Good
Media	Public Presentation	0.92	Good
	Organization		
	General View	0.71	Good
Language	Module Completeness	0.88	Good
	Suitability to Student	0.85	Good
	Development Level		
	Legibility	0.88	Good
	Straightforwardness	0.94	Good
	Suitability	0.88	Good
	Use of Terms and Symbols/Insignia	0.81	Good

Products that have been declared suitable for use are then used in learning on a limited basis. This study only tests the expected effectiveness of the product being developed. Expected effectiveness is the effectiveness of the product which is expected to improve students' critical thinking skills. Limited trials were carried out on 14 students who were taking biodiversity courses. Learning is carried out using an encyclopedia of flora on Curiak Island. Before and after learning, students are given questions containing indicators of critical thinking. The results of limited trials are presented in Table 3.

Table 3. Descriptive Statistics of Student Score Results

	N	Mean	Std. Deviation
Pretest	14	21.00	4.43
Posttest	14	75.00	5.24

The value obtained is the value accumulated from answers based on four indicators of critical thinking. Next, to find out whether there are differences in students' critical thinking abilities before and after

learning. The difference test was carried out using a paired sample t-test by first carrying out a normality test. The normality test results obtained a sig value. 0.005 for pretest and 0.010 for posttest. Sig value. which is > 0.005 indicates that the data is normally distributed so that it can be continued for a different test using a paired sample t-test. The results of the paired sample t-test are presented in Table 4.

Table 4. Paired Sample T-Test Results

	Sig. (2-tailed)
Pair Pretest - Posttest	0.000

Table 4 shows that the results of the difference test using the paired sample t-test obtained a sig value. < 0.05 so it can be said that the hypothesis is accepted. H0 is accepted, indicating that there are differences in students' critical thinking abilities before and after learning using the flora encyclopedia on Curiak Island. The significance of differences in test results only shows the expected effectiveness of a product during limited trials. Critical thinking abilities can begin to improve when students have a high sense of curiosity (Budi & Sukmono, 2023; Indrawati et al., 2023)

According to Artinta et al. (2021), the formation of curiosity is influenced by the subject matter, teacher motivation, teacher apperception, asking questions, the child's enthusiasm, interest in learning and gender. Factors that influence problem-solving abilities, but in general, the strategies used by teachers are the main thing in learning (Anisa et al., 2017; Daemicke et al., 2020). An encyclopedia with content that is fresh and relevant to everyday life awakens students' interest in studying it. The motivation that arises to study floral diversity material can trigger critical thinking skills (Fadhilah et al., 2022; Suparya, 2020).

Another thing that is reviewed from this learning is the increase in each indicator of students' critical thinking abilities. The increase in critical thinking skills for each indicator was analyzed using N-Gain which is presented in Table 5.

Table 5. Results of N-Gain Critical Thinking Ability

Indicator	N-Gain	Categorize
Interpretation	0.50	Medium
Analysis	1.00	High
Inference	0.57	Medium
Explanation	0.67	Medium
Mean	0.69	Medium

Table 5 shows that overall critical thinking N-Gain is in the medium category. There are four indicators reviewed in this research. The indicator that experienced a high increase was the second indicator, namely analysis in the high category. Analytical

indicators of critical thinking can be high for several reasons. The encyclopedia developed contains factual information or data regarding the flora on Curiak Island. The factual data presented facilitates students to practice analyzing data critically (Hernawati et al., 2018; Rosnawati & Sunaryati, 2021). Meanwhile, other indicators obtained the medium category. This finding is in line with the findings Wiyoko (2019) other indicators obtained the medium category. There are factors that cause this to happen, one of which is students' incomplete knowledge. Understanding data and the ability to interpret information effectively is an essential aspect of data analysis. However, several factors can make the data interpretation and data explanation indicators fall into the medium category. In the moderate category, individuals may have basic abilities in data interpretation, but still need further efforts to improve understanding, overcome possible obstacles, and improve their analytical skills (Bustami et al., 2018; Fitriani et al., 2019; Khasanah & Prayitno, 2017). Fragmented knowledge can lead to less accuracy in interpreting the data obtained and even in drawing conclusions. Overall, each indicator needs to be reviewed further, because there are many factors that can cause an increase in capability to occur. The increase that occurs shows that the encyclopedia used can help learning. The results of this hope effectiveness test can become material for improving the product in extensive trials

Conclusion

This research provides an illustration that the encyclopedia product was developed by containing material about farming flora on Curiak Island. The product is used in biodiversity courses which are important to support knowledge of the surrounding flora and fauna. The findings show that the product developed is feasible in terms of material, media and language. The test results show that there is a significant difference in students' critical thinking abilities before and after learning. Apart from that, the analysis indicator in critical thinking skills obtained the highest score in the medium category. These findings illustrate that the effectiveness of product expectations is effective in improving students' critical thinking abilities. However, future research needs to conduct several reviews regarding factors that can improve students' critical thinking abilities on each indicator. In addition, it is necessary to carry out extensive trials in the use of the products being developed.

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Author Contributions

Conceptualization, M.M.S.; methodology, D.P.; formal analysis, D.P.; investigation, M.M.S and R.Y.; data curation, D.P.; writing—original draft preparation, D.P.; R.Y.; dan M.M.S.; writing—review and editing, D.P.; and M.M.S, R.Y., and D.P. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The author(s) declared no potential conflicts of interest concerning this article's research, authorship, and/or publication.

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