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Development of Biology Teaching Modules on Biodiversity Material Based on Regional Potential to Improve Literacy Skills of Grade X Students of SMA Negeri 1 Tenggarong

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Abstract: The purpose of this study was to determine the analysis of teacher and student needs for teaching modules based on regional potential, module validity, level of practicality, and effectiveness of the module in improving students' literacy skills. This study is a development research. Data were analyzed using qualitative and quantitative methods. Qualitative descriptive analysis was used to analyze data on needs, validity, and practicality of the module, while quantitative analysis was used to test the effectiveness of the module. The results of the needs analysis showed that teachers needed modules that were relevant to the local context, and students needed interesting and easy-to-understand learning media. Expert validation showed that the module had a validity index of 97.73% with a very valid category. The practicality level of the module reached 78% with a practical category. Effectiveness testing using the independent sample t-test produced a sig value. (2-tailed) of 0.000 (<0.05), which shows that the module is effective in improving students' literacy skills. The conclusion of this study is that the regional potential-based teaching module is valid, practical, and effective in improving students' literacy skills in biodiversity material.

Keywords: Biodiversity; Regional potential; Student literacy; Teaching modules

Introduction

Education plays a central role in the development of a country throughout the world. In a literal context, education can be interpreted as a systematic plan, covering various aspects of assessment, and aims to support the development of knowledge, attitudes, and specific skills that are relevant in community life (Mahmoud, 2011). The education system needs to be improved in several key aspects such as curriculum, teaching system, teachers, teaching methods and learning models. A well-systematic and easy-to-implement curriculum allows educators and students to be more motivated and happy in learning (Ghani et al., 2021; Sari, 2018). However, a good, systematic and integrated curriculum sometimes still has obstacles in its implementation in the field. These obstacles arise because of the weak ability of educators to implement the curriculum.

Process is not only a teaching and learning process but also a process of how learning impacts the cognitive aspect (knowledge) and is supported by improving good attitudes and behavior (affective). Both cognitive and affective abilities must be supported by good physical abilities (psychomotor) so that they can create integrated and good learning. Learning in the 4.0 era emphasizes the aspect of critical thinking skills (Jalani et al., 2015), learning based on critical thinking skills can be

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applied to various learning models so that educators must be able to sort and use them according to the material and models taught.

Classroom learning must be made as interesting as possible so that curiosity arises in students, in learning exact sciences such as science learning requires good critical thinking skills and high interest in the learning (Istiana et al., 2018). The importance of structured and systematic science learning cannot be underestimated, considering that the essence of this learning should create a positive impact on students' understanding and feel its benefits in everyday life. However, the reality faced by Indonesia, as reflected in the 2018 PISA (Program for International Student Assessment) data, shows that Indonesian students' literacy skills are ranked 74th, while science learning itself is ranked 71st. This fact illustrates that the literacy rate in Indonesia is still low and is a call for the education system to take concrete action to improve the quality of learning.

Improving students' literacy skills can begin by making educators understand what are the standards in literacy learning, especially in science learning. Science literacy is the ability to use scientific knowledge, identify questions and describe evidence based on conclusions to be able to understand and help make conclusions about nature and its changes by humans (Yuliati, 2017). Science literacy learning that is also related to nature and its changes by humans is biology learning, the concept of biology learning is closely related to how nature and humans are interconnected and what impacts they have on life (Lutfiah et al., 2021; Norris et al., 2003).

Biology learning is essentially a science learning that is taught since students take elementary school to college, so there needs to be comprehensive, applicable learning and a valid assessment system to measure it. In biology learning for students in high schools, for example, it emphasizes an applied learning system and does not have to emphasize theoretical learning aspects. Learning must emphasize aspects of how authentic learning can be combined with understanding-based learning and field studies (Yew et al., 2016). Field learning in biology lessons is closely related to literacy learning by students (Abbas et al., 2012).

The biology learning process applied by teachers in Kutai Kartanegara Regency, especially in Tenggarong District based on the results of preliminary observations by researchers, showed results that were not in accordance with expectations and the objectives of the learning itself, from 285 respondents who answered the questionnaire, 41.5% of students still experienced difficulties in learning biology, 29% of students were still taught using the lecture method where the method was less interesting in terms of motivation and interest in learning students, so that it also had an impact on scientific literacy skills, especially student literacy. On the other hand, 35.8% of students still experienced obstacles in using the learning methods taught by teachers, because the method was not supported by modules or books that applied the method.

In line with the preliminary research conducted on students, the preliminary research given to teachers also revealed the same thing, as many as 42.9% of teachers have not attended the independent curriculum implementation workshop, so that many teachers still feel unable to implement the learning process according to student demands, in line with this, 43% of teachers also still apply lecture-based learning, where science or biology learning should apply more experimental learning or problem solving. In line with these findings, as many as 57% of teachers also have difficulty in delivering the material, especially using certain methods. Thus, there is a need for a book or module that can support the improvement in the use of these methods. In addition, there has been no development of teaching modules based on the development of the potential biodiversity of the Kutai Kartanegara area.

Biodiversity, or biological diversity, encompasses the variety of life on Earth in all its forms, including genetic, species, and ecosystem differences. It includes all forms of life, from microorganisms to large animals, and the ecosystems in which they live. Borneo, as the world's largest island, has one of the richest and most complex biodiversity in the world. The island has a variety of ecosystems, from tropical rainforests to wetlands and coastlines, supporting thousands of species of flora and fauna. Borneo is divided into 5 large provinces, namely; North Kalimantan, Central Kalimantan, West Kalimantan, South Kalimantan and East Kalimantan with an area of 743,300 km2 making it an island with very high biodiversity.

Kutai Kartanegara as one of the areas in East Kalimantan Province has a variety of biodiversity that is also rich and diverse. However, currently the threat to the destruction of this biodiversity is something that needs to be considered together. Biodiversity in Kutai Kartanegara faces threats from deforestation, forest encroachment, mining, and climate change. Conservation and preservation efforts are very important to maintain this natural wealth. In addition, there are other things that can be done to protect against these threats, one of which is to introduce the potential for diversity through learning and teaching materials by biology teachers in schools. Silaban et al. (2024) stated that in line with the demands of the independent curriculum, which expects a contextual learning process that touches and answers local problems from around, the solution that can answer this problem is a local-based learning approach that is integrated into biology lessons.

The Mahakam dolphin (Orcaela brevirostris) is one of the aquatic mammals whose population is decreasing, vulnerable and endangered, including animals protected by the state. The results of the identification from 1999 to 2019, the main habitat of the dolphin is the waters in Kutai Kartanegara starting from Muara Kaman, Batuk, Kedang Rantau River, Kedang Kepala, Belayan Pela and Batubumbun (Nur et al., 2022). Native Kalimantan plants found in the Tabang Arboretum, Kutai Kartanegara Regency have high conservation and ecological value, Ulin (Eusyderoxylon swagery), red meranti (Shorea smithiana) and bamgkirai (Shorea laevis) (Sitepu et al., 2023).

Based on this, the researcher feels the need for an application of a teaching module in biology learning that provides space and opportunity for students to explore through activities that are in accordance with the concept or subject matter. Exploration activities can certainly help students in learning and building critical thinking skills and problem solving in order to gain deeper knowledge and improve students' literacy skills. So, if students in the learning process find a problem, then students can solve a problem by applying the knowledge they have or trying to find out the knowledge needed. Therefore, the purpose of this study is to determine the analysis of teacher and student needs for teaching modules based on regional potential, module validity, level of practicality, and effectiveness of the module in improving students' literacy skills.

Method

This type of research is Research and Development research. Research and Development (R&D) research is a research process designed to produce or develop a new product, system, or method, or to improve an existing one.

The product to be researched and developed in this study is a Biology teaching module for biodiversity material based on regional potential of SMAN 1 Tenggarong Class X, which consists of RPP, Teaching Materials, LKPD (Student Worksheets) and Assessment Instruments. The population in this study were all class X students of SMA Negeri 1 Tenggarong who were registered in the 2024/2025 academic year of class X SMA Negeri 1 Tenggarong. While the sample in this study used a random sampling technique, namely a technique for taking sample members from the population which is carried out randomly without considering the strata in the population.

The model used in this study is the Borg et al. (1998) research and development model. According to Borg et al. (1998), development research has nine main development steps which include: (1) investigation and information collection, including literature studies, field observations, and report preparation, (2) planning, (3) development of initial product forms, (4) initial field trials, (5) main product revision, (6) main field trials, (7) field operational trials, (8) final product revision. These nine steps can be summarized into 10 stages, namely: 1) Identification of Potential and Problems, 2) Data Collection, 3) Product Design, 4) Design Validation, 5) Design Revision, 6) Product Trials, 7) Product Revisions, 8) Usage Trials, 9) Product Revisions, and 10) Mass Product Implementation.

The research instruments used were tests and non-tests. The test was conducted by giving a pretest and posttest in learning in the form of multiple-choice questions totaling 25 questions. This test aims to determine whether there is an increase in students' literacy skills. Literacy skills are measured using indicators, namely (a) Accessing and retrieving information from texts; (b) integrating and interpreting reading content; (c) reflecting and evaluating texts; and (d) connecting text content with experience. Non-tests are in the form of teacher and student response questionnaires and observation sheets used to directly observe the learning process using biology teaching modules. Data analysis techniques in the study include: for validity and practicality tests, the Percentage Index formula is used:

$$I\,\% = \frac{Total\ Assessment\ Score}{Maximum\ Score} \times 100\% \quad (1)$$

Then, to test the effectiveness, the Independent Sample T-Test was used with the help of the SPSS program.

Results and Discussion

Teaching Module Validation Results

Validity value given by validator to the design of Biology Teaching Module on Biodiversity Material based on Regional Potential. The presentation component obtained the largest Percentage Index, which is 82%. While the smallest Percentage Index was given to the graphic component, which is 80.7%. Details of the complete learning device validation data can be seen in table 1.

Table 1. Percentage Index of Validation of Learning Experts' Assessment Results of Validators

Components of Learning Devices that are Assessed	Percentage index (%)	Learning Devices Percentage Index (%)
Presentation		
a. Technique	78	
b. Material	85	82
c. Presentation	83	
Graphics		
a. Module Size/Format	80	
b. Cover section design	81	80.7
c. Content section design	82	
d. Paper Quality	80	
Validity		Valid

The validator provides recommendations for learning devices that are suitable for use with revisions according to suggestions. The suggestions are as follows: In general, this learning module is considered suitable for use with several revisions to the aspects of learning objectives, learning activities, and assessment formats. The proposed revisions aim to improve the clarity, relevance, and effectiveness of the module in supporting an optimal learning process.

Media Validation Results for Linguists

Validity value given by validator to the design of Biology Teaching Module on Biodiversity Material based on Regional Potential. The readability component obtained the largest Percentage Index, which is 85%. While the smallest Percentage Index was given to the other two components, which is 80%. Details of the complete learning device validation data can be seen in table 2.

Table 2. Percentage Index of Validation of Learning Experts' Assessment Results of Validators

Components of Learning Devices that are Assessed	Percentage index (%)	Learning Devices Percentage Index (%)
Linguistics		
a. Legibility	85	
b. Conformity of rules	80	81.7
c. Language Logic	80	
Validity		Valid

Expert validators provided notes on improvements to the product design. The content presented in this module has covered various aspects of knowledge relevant to the curriculum and learning objectives. The material that has been compiled is systematic and in-depth, so that it can provide a comprehensive understanding to students. However, the validator team found several words and spellings that were not in accordance with good and correct Indonesian language rules. The language used in this module is generally good enough and easy for students to understand. However, there are several sentences that are less effective and several terms that are not used correctly.

Material Validation Results for Material Experts

The presentation component obtained the largest Percentage Index, namely 81.7%. Details of the complete learning device validation data can be seen in table 3.

Table 3. Percentage Index of Validation of Material Experts from Validator Assessment Results

Components of Learning Devices that are Assessed	Percentage index (%)	Learning Devices Percentage Index (%)
Presentation		
a. Technique	78	
b. Material	85	81.7
c. Presentation	83	
d. Suitability of content to child development		
e. Substance of Science		
f. Advanced and developing insights		
g. Diversity of social values		
Validity		Valid

The researcher conducted a stage I revision of the teaching module design consisting of RPP, LKPD, teaching materials, and assessments according to the suggestions of the validator. After the learning device was revised, the learning device was validated again by the validator. The validation results of the product

design of the Biology Teaching Module for Biodiversity Material based on Regional Potential showed the Percentage Index data for learning devices of 97.73 with very valid validity criteria. The validator provided recommendations for the design of the Biology Teaching Module for Biodiversity Material based on Regional Potential learning devices that are suitable for use in learning in high school without major revisions.

Table 4. Percentage Index of Revised Learning Devices

Components of Learning Devices that are Assessed	Percentage index (%)	Learning Devices Percentage Index (%)
Lesson Plan	96.36	
Teaching materials	97.14	
LPKD	96.01	97.1
Instructional Media	97.77	
Evaluation instruments	98.18	
Validity		Very Valid

Results of Student Practicality Response Analysis

Student response data was obtained by asking students to fill out a questionnaire by checking the numbers 1-5 on the linkert scale for each statement in the questionnaire. The results of the analysis obtained a percentage index of 78%. Based on the interpretation of the criteria for the level of practicality, the percentage index of 78% indicates that the product of the development of the Biology Teaching Module learning device for Biodiversity Material based on Regional Potential is very practical to use in learning. Students generally feel that the sentences and paragraphs in the module are clear and easy to understand, with around 66.3% of students strongly agreeing and 63.3% agreeing that the language used is simple and helps them understand the lesson. This is important to ensure that students can follow the material easily without language barriers.

As many as 78.6% of students agreed that the module helped them focus more on learning biodiversity material, and 74.5% of students felt that this module made them more enthusiastic about learning. The visual appearance of the module was also considered attractive by 75.5% of students, who stated that the module design provided a good overview of the content (Harahap et al., 2024).

One of the unique aspects of this module is its approach that integrates the local potential of Kutai Kartanegara Regency. As many as 72.4% of students agreed that the illustrations in this module were related to their surroundings, while 66.4% of students felt that the module used real examples from the lives of local people. This approach has been proven to make students more interested, as well as increase their awareness and concern for the surrounding environment.

The module also successfully encouraged students to care more about their environment, with 75.5% of students agreeing that the module helped them become more aware of the importance of conserving biodiversity. This approach not only provides knowledge, but also promotes relevant social and environmental values.

This module contains a summative test that aims to measure students' understanding of the material on biodiversity based on regional potential. As many as 78.6% of students agreed that this test was effective in testing their understanding, which helps in evaluating whether students have understood the material in depth.

Overall, the results of the practicality test indicate that this regional potential-based biology teaching module is very suitable for use in the learning process. This module not only meets the criteria of practicality, but is also welcomed by students because of its simplicity in language, its relevance to the local context, and its visual appeal. These aspects support the success of this module in improving students' scientific literacy with a contextual and relevant approach.

Results of Model Development Effectiveness Test

The product of the development of the Biology Teaching Module learning device on Biodiversity Material based on Regional Potential which has been declared feasible by the validator and declared very practical when conducting a limited trial, is applied in the treatment class carried out by biology teachers at SMAN 1 Tenggarong. Class X-2 is used by the author as the treatment class.

The biology teacher carries out biology learning in class X-2 using the development product of the Biology Teaching Module on Biodiversity Material based on Regional Potential which has been declared very valid by the validator, has a very practical level of practicality and has been revised again based on their input. The steps for implementing the learning take place like the model he observed in class X-2 in accordance with the syntax of the learning model.

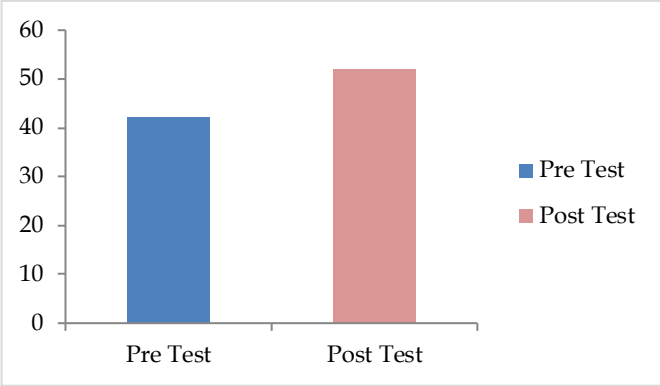

Figure 1. Diagram of literacy score results of SMAN 1 Tenggarong

Table 5. Results of Independent Sample t-Test

Independent Samples Test						
		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Test Results	Equal variances assume	.002	.96	-6.50	62	.00
	Equal variances not assume			-6.50	60,618	.00

The results of the average pre-test and post-test scores of students can be seen in Figure 1, which shows an increase in the average scores of students in the treatment class or in the quasi-experimental class. The pre-test and post-literacy scores of students were 40.75 and 55.25, respectively. The data on the average pre-test and post-test scores were analyzed for differences using the Independent sample t-test.

With Equal Variance the Sig. value (2-tailed) = 0.000. Since the significance value is less than 0.05, it can be concluded that there is a significant difference in the average between the two groups. Based on the results of the t-test, there is a significant difference between the averages of the two groups. A p-value <0.05 indicates that this difference is statistically significant.

The results of the statistical analysis showed that the use of regional potential-based biology teaching modules was effective in improving students' biological literacy skills. A significant increase in the average post-test score of the experimental class compared to the control class showed that this module succeeded in enriching students' understanding of the material, especially with a contextual approach involving the local potential of Kutai Kartanegara. This is in accordance with previous studies showing that the developed module is effective in improving students' scientific literacy and other abilities (Fadhilah, 2021; Hapsari et al., 2016; Hasmiati et al., 2023; Kahar et al., 2019).

Integrating local potential into teaching materials has proven to be an innovative approach that can bridge the gap between theoretical and contextual learning (Li et al., 2023; Srg et al., 2024; Tpoenifu et al., 2023; Ulya et al., 2022). In this study, the development of a Biology teaching module based on the potential biodiversity of the Kutai Kartanegara area not only provides students with a deep conceptual understanding but also fosters a sense of concern for their local environment. This approach allows students to see the direct relevance between the material being studied and their daily lives, thereby increasing learning motivation and scientific literacy skills (Sunarsih et al., 2020).

The biodiversity utilized in the teaching module includes flora, fauna, and unique ecosystems that are characteristic of Kutai Kartanegara. Some examples of biodiversity in this area include:

Ironwood tree (Eusideroxylon zwageri), which is a typical Kalimantan wood with high ecological and economic value. Black orchid (Coelogyne pandurata), an endemic flower of Kalimantan which is famous for its beauty and rarity. Pitcher plants (Nepenthes spp.), which have important ecological functions in their habitat.

Bornean orangutan (Pongo pygmaeus), an endangered primate species and a symbol of conservation. Proboscis monkey (Nasalis larvatus), an endemic primate of Borneo with unique characteristics on its nose. Arowana fish (Scleropages formosus), known as an ornamental fish with high cultural and economic value.

By integrating these elements, the teaching module not only facilitates local context-based learning but also strengthens students' connectedness to their environment. This module provides a holistic learning experience, where students are invited to understand the relationship between biodiversity and its sustainability for the sustainability of life.

This approach also has a long-term impact, namely creating a generation that is more environmentally

aware and actively involved in conservation efforts. Thus, the integration of local potential is not only relevant to Biology learning, but also a strategic step to build sustainable ecological awareness among students and the community (Pitman et al., 2018).

Thus, this module is not only valid and practical, but also effective in supporting the achievement of better learning outcomes in students, especially in the topic of biodiversity. This shows that the integration of regional potential into teaching materials can be a very useful approach for biology education at the high school level, especially at SMA Negeri 1 Tenggarong.

Conclusion

Based on the description and discussion of research results it is known that expert validation shows that the module has a validity index of 97.73% with a very valid category. The practicality level of the module reaches 78% with a practical category. Effectiveness testing using the independent sample t-test produces a sig. (2-tailed) value of 0.000 (<0.05), which shows that the module is effective in improving students' literacy skills. So that the regional potential-based teaching module is valid, practical, and effective in improving students' literacy skills in biodiversity material.

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Author Contributions
Conceptualization, L, V. M. M. R., and A; methodology, H, E. T. M., and D; validation, L, V. M. M. R., and A.; formal analysis, H, E. T. M., and D.; investigation, L, V. M. M. R., and A.; resources, H, E. T. M., and D.; data curation, L, V. M. M. R., and A.: writing—original draft preparation, H, E. T. M., and D.; writing—review and editing, L, V. M. M. R., and A.: visualization, R. N., and H. All authors have read and agreed to the published version of the manuscript.

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