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Development of a Science Module Based on Problem-Based Learning with an Ecotourism Perspective in Tahura Nuraksa NTB

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Abstract— Education plays a crucial role in shaping high-quality human resources. The implementation of an independent curriculum requires teachers to foster critical thinking, exploration, and problem-solving skills in students. This study aims to develop a science module based on Problem-Based Learning (PBL) with an ecotourism perspective in Tahura Nuraksa NTB using the 4-D development model (Define, Design, Develop, Disseminate). The developed module enables direct observation of natural phenomena, promotes systematic and analytical thinking, and employs concise, clear language supported by relevant images. The findings indicate that this module enhances student engagement and conceptual understanding, making it an effective learning resource in science education.

Keywords— Science Module; Problem-Based Learning; Ecotourism; Tahura Nuraksa NTB.
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1. Introduction

Science education shapes students' understanding and awareness of the environment. One instructional approach that can enhance students' conceptual understanding is Problem-Based Learning (PBL). PBL is a learning approach that encourages students to think critically and solve problems based on real-world situations [1][2]. By integrating an ecotourism perspective, this approach can strengthen the connection between science learning and environmental issues around students [3].

Tahura Nuraksa (Nuraksa Grand Forest Park) in West Nusa Tenggara is a conservation area rich in biodiversity and can potentially serve as an environmental-based learning resource [4]. However, the utilization of this area in science education at schools remains limited. A PBL-based learning module with an ecotourism perspective can help students understand scientific concepts in a more contextual and applicable manner [5][6].

A learning module designed using the PBL approach can enhance students' critical thinking skills, problem-solving abilities, and environmental awareness [7][8]. This approach can also foster a sense of responsibility toward the environment and increase student engagement in nature conservation [9]. Studies indicate that PBL effectively improves student engagement in learning [10] and promotes more profound conceptual mastery [11].

Several studies also reveal that PBL can enhance students' understanding of various scientific disciplines [12]. This method improves conceptual understanding and encourages critical thinking and collaborative abilities [13]. Therefore, developing a PBL-based science module with an ecotourism perspective in Tahura Nuraksa, West Nusa Tenggara, represents a strategic step to enhance the effectiveness of science learning while supporting environmental conservation efforts [14][15].

2. Materials and Method

This study employs the Research and Development (R&D) method using the 4-D model [16][17], which consists of: 1) Define: Analyzing learning needs and basic competencies; 2) Design: Designing a PBL-based module format with an ecotourism perspective; 3) Develop: Developing and testing the module through expert validation and limited trials; and 4) Disseminate: Distributing the product within the educational environment. The module was evaluated through expert reviews and trials with students, with data collected via interviews, observation sheets, and pretest-posttest assessments.

3. Results and Discussion

The results of this study are in the form of a design for a science module with a PBL model and an ecotourism insight of Tahura Nuraksa NTB for class VII, semester 1, on the material of interactions between living things and their environment. The following describes the strategy for developing a science module with a PBL model and an ecotourism insight into Tahura Nuraksa NTB.

3.1 Conceptual Framework of the Module

This module is designed to help students develop critical, analytical, and systematic thinking skills through an engaging and interactive learning approach. Using natural phenomena in Tahura Nuraksa NTB as case studies, students are encouraged to explore real-world environmental challenges, analyze data, and propose evidence-based solutions. The problem-based learning (PBL) framework enables students to actively engage in inquiry, discussion, and collaborative problem-solving, fostering a deeper understanding of ecological systems and their complexities. Through this process, students enhance their cognitive abilities and develop practical environmental assessment and decision-making skills.

3.2 Description of the Module Model

The module is structured to provide a comprehensive and systematic learning experience, ensuring students develop a deep understanding of the subject matter [18][19]. It consists of the following sections:

3.2.1 Introduction

This section briefly overviews the module, outlining its objectives and relevance to student learning. It includes a description of the core competencies students are expected to achieve and detailed instructions on effectively using the module for optimal learning outcomes.

3.2.2 Learning Activities

This core section of the module is designed to engage students through various interactive and problem-based learning (PBL) activities. It includes: 1) Learning Indicators: Clearly defined learning outcomes that guide students in understanding key concepts; 2) Problem-Based Learning (PBL) Activities: Case studies and real-world problem scenarios that encourage critical thinking, inquiry, and collaborative problem-solving; 3) Assignments: Structured tasks that reinforce learning and allow students to apply concepts in different contexts; 4) Formative Tests: Periodic assessments designed to evaluate student's progress and understanding before advancing to the next stage.

3.2.3 Final Module Test

A comprehensive assessment measures students' overall understanding of the material covered in the module. This summative test ensures that students have met the learning objectives and are prepared to apply their knowledge in practical or real-world situations.

3.2.4 Appendices and References

This section includes supplementary materials such as additional readings, data sources, glossaries, or supporting documents that enhance the learning process. It also provides a list of references and resources students can explore for further study.

3.3 Module Display

The following is a display of the science module of the PBL model with an ecotourism perspective in Tahura Nuraksa NTB.

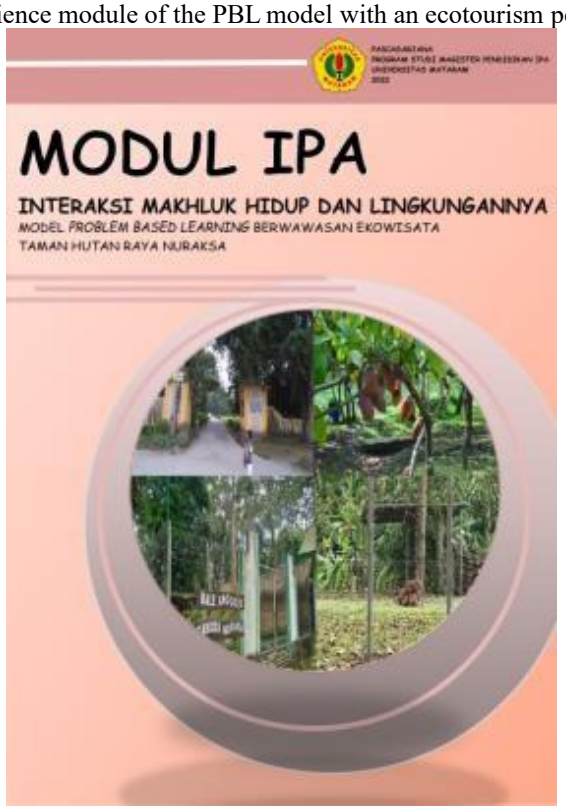

Fig.1. Module Cover

Figure 1 is the cover page of the science learning module titled Interaction of Living Organisms and Their Environment. The module applies a Problem-Based Learning (PBL) model with an ecotourism perspective, using Tahura Nuraksa in West Nusa Tenggara as a case study. The cover prominently displays the module title, university logo, and images of the natural environment in Tahura Nuraksa, which serves as the primary learning focus of this module.


PENDAHULUAN

INTERAKSI MAKHLUK HIDUP DENGAN LINGKUNGANNYA

A. DESKRIPSI SINGKAT

Hai Anda semua apa kabarnya? Mudah-mudahan Anda dalam keadaan sehat walafiat. Modul yang akan Anda pelajari sekarang berjudul **"Interaksi Makluk Hidup dengan Lingkungannya"**. Adapun tujuan Anda mempelajari modul ini, diharapakan Anda mampu enjelaskan konsep lingkungan dan komponen-komponennya berkaitan dengan Taman Hutan Raya Nuraksa, mampu menjelaskan pengaruh komponen abiotik terhadap komponen biotik dalam suatu ekosistem Taman Hutan Raya Nuraksa, mampu melakukan pengamatan lingkungan dan mengidentifikasi komponen biotik dan abiotik, mampu menjelaskan pengertian interaksi, mampu menjabarkan pola-pola interaksi, mampu menjelaskan konsep bentuk saling ketergantungan antara komponen biotik dan abiotik, dan mampu menyebutkan perbedaan antara rantai makanan dengan jaring-jaring makanan.

Sebelum masuk pada materi mari kita mengenal tempat ekowisata yang bisa digunakan sebagai tempat untuk mengaplikasi pengetahuan kita mengenai materi yang akan kita pelajari, adapun tempat yang Anda jadikan sebagai tempat untuk menambah ilmu pengetahuan tentang materi **"Interaksi Makluk Hidup dengan Lingkungannya"** ialah Taman Hutan Raya Nuraksa yang terletak di Dusun Kumbi, Desa Pakuan, Kecamatan Narmada, Kabupaten Lombok Barat, Provinsi Nusa Tenggara Barat. Taman Hutan Raya Nuraksa adalah kawasan pelestarian alam yang bertujuan untuk mengoleksi tumbuhan dan/atau satwa yang dimanfaatkan untuk penelitian, ilmu pengetahuan, pendidikan, penunjang budidaya, budaya, pariwisata dan rekreasi.

Fig.2. Introduction

Figure 2 is the introduction section of the module. It provides a brief description of the module's content and objectives. The module aims to help students understand the interactions between living organisms and their environment in Tahura Nuraksa. The learning approach is exploratory, encouraging students to analyze natural phenomena in the area to gain a deeper understanding of ecological concepts.


Kegiatan Belajar 1

LINGKUNGAN

A. Indikator Pembelajaran

Setelah mempelajari materi pembelajaran kegiatan belajar 1 ini diharapkan Ananda dapat:

1. Menjelaskan konsep lingkungan dan komponen-komponennya berkaitan dengan Taman Hutan Raya Nuraksa
2. Menjelaskan pengaruh komponen abiotik terhadap komponen biotik dalam suatu ekosistem Taman Hutan Raya Nuraksa

B. Aktivitas Pembelajaran

Strategi Literasi dalam Pembelajaran

Setelah selesai mempelajari materi pembelajaran yang diuraikan pada Kegiatan Belajar 1, Ananda diharapkan dapat mempelajari interaksi makhluk hidup dengan lingkungannya. Pelajarilah secara seksama masing-masing topik dari materi pembelajaran yang diuraikan! Satu hal yang penting untuk Ananda lakukan dalam mempelajari modul ini adalah membuat catatan-catatan tentang materi pembelajaran yang belum ataupun sulit Ananda pahami.

Dalam mempelajari materi pembelajaran yang disajikan pada Kegiatan Belajar 1 ini, Ananda akan menjumpai soal-soal latihan. Usahakanlah semaksimal mungkin untuk mengerjakan semua soal latihan tanpa terlebih dahulu melihat kunci jawaban yang disediakan pada bagian akhir modul ini.

Ananda baru diperkenankan untuk mempelajari materi pembelajaran yang diuraikan pada Kegiatan Belajar 2 setelah berhasil mengerjakan 75% soal-soal latihan yang terdapat pada Kegiatan Belajar 1 dengan benar. Jika setelah mengerjakan soal-soal latihan, Ananda belum berhasil menjawab 75% benar, jangan berkecil hati. Cobalah pelajari kembali secara lebih cermat materi pembelajaran yang masih belum sepenuhnya Ananda pahami tersebut. Kemudian, kerjakan kembali soal-soal latihannya. Semoga kali ini Ananda lebih berhasil.

Fig.3. Learning Activity 1: Environment

Figure 3 marks the beginning of the first learning activity in the module, which discusses the concept of the environment. It includes learning indicators that outline the competencies students should achieve after studying this material. Additionally, literacy strategies are introduced to guide students in understanding and exploring the topic of the environment and the ecosystem components found in Tahura Nuraksa.

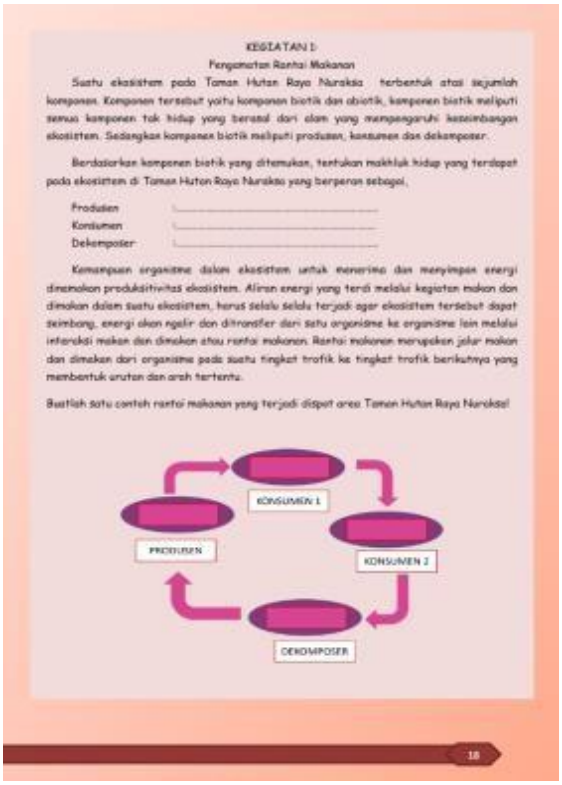

Fig.4. Activity: Food Chain

Figure 4 presents one of the learning activities in the module, focusing on the food chain within the Tahura Nuraksa ecosystem. It explains that ecosystems consist of biotic and abiotic components that interact. The page also features a food chain diagram illustrating the roles of producers, primary consumers, secondary consumers, and decomposers in the energy flow of the ecosystem. Students are assigned to create food chain examples based on their observations of the Tahura Nuraksa ecosystem.

This module is designed to help students understand ecological concepts through a problem-based learning approach and direct exploration of real-world environments.

3.4 Implementation Module in Learning

Developing a science module based on Problem-Based Learning (PBL) with an ecotourism perspective in Tahura Nuraksa, West Nusa Tenggara (NTB), aims to enhance students' understanding of ecological concepts through real-world problem-solving. This module integrates environmental education with an ecotourism approach, encouraging students to explore, analyze, and propose solutions to sustainability challenges in Tahura Nuraksa.

The module is implemented in six structured PBL stages, designed to promote critical thinking, collaboration, and scientific inquiry: (1) Presenting Learning Objectives and Forming Student Groups: The learning process begins with clearly explaining the objectives, ensuring students understand the expected competencies. Students are then divided into small groups to facilitate discussion, teamwork, and active engagement in problem-solving; (2) Introducing Problems Related to Ecotourism: Students are presented with real-world challenges related to ecotourism in Tahura Nuraksa, such as biodiversity conservation, sustainable resource management, and the impact of tourism on local ecosystems. These contextual problems serve as the foundation for inquiry and exploration; (3) Conducting Investigations and Data Collection: To deepen their understanding, students engage in hands-on investigations, including field observations, data collection, and literature reviews. They explore ecological interactions, environmental conditions, and the role of ecotourism in conservation efforts; (4) Analyzing Data and Solving Problems: Using the collected data, students critically analyze findings, identify patterns, and develop scientifically sound solutions to the identified problems. This stage encourages analytical thinking and evidence-based reasoning; (5) Compiling Reports on Investigation Findings: Each group synthesizes its research into a structured report detailing its investigative process, data analysis, and proposed solutions. This step reinforces students' ability to communicate scientific findings effectively; and (6) Reflecting and Presenting Results: The learning process concludes with group presentations, where students share their findings and solutions with peers. This stage includes a reflection session, allowing students to evaluate their learning experience, discuss challenges encountered, and refine their scientific reasoning skills.

The trial involved two groups of students: the Experimental Group (using the PBL module) and the Control Group (using conventional methods). Each group consisted of 30 students. Conceptual understanding was assessed before and after the learning process, with the following results:

Table 1. Results of pre-test and post-test of students' conceptual understanding

Group	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Increase (%)
Experimental	65.2 ± 8.4	80.3 ± 7.9	15.1%
Control	64.8 ± 8.1	71.6 ± 7.5	6.8%

To compare the improvement in conceptual understanding between the two groups, an independent t-test was conducted, yielding the following results: (1) The increase in conceptual understanding in the experimental group (15.1%) was significantly higher than in the control group (6.8%); (2) The t-test results indicate a statistically significant difference (p-value = 0.0001), meaning that the PBL-based module has a meaningful impact on students' conceptual understanding; and (3) The effect size of 1.02 suggests that the PBL-based module has a significant effect in enhancing students' learning outcomes compared to conventional methods.

The module's effectiveness was assessed through a trial implementation, which revealed a 15% increase in students' conceptual understanding compared to conventional teaching methods. These enhanced students' comprehension of ecological principles, and results indicate that integrating Problem-Based Learning with an ecotourism perspective enhances students' comprehension of the ecological tenets and fosters problem-solving skills, environmental awareness, and engagement with real-world sustainability issues.

4. Conclusion

Based on the discussion described, the science module of the PBL model with an ecotourism insight of Tahura Nuraksa NTB for class VII semester 1 material on the interaction of living things with their environment. The analysis results concluded that this module has unique and different characteristics than other modules. The development strategy for this module contains several factors, including (1) using a model, (2) containing natural phenomena related to Tahura Nuraksa NTB which are observed directly, (3) facilitating students in developing their thinking skills systematically, critically, and logically, and analytically so that they can formulate their learning conclusions with confidence, and (4) using short, clear, easy-to-understand and comprehend language, and using supporting images related to the phenomena described.

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