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Development of e-module based on problem-based learning on human respiratory organs for grade V UPT SDN 11 Tiumang, Dharmasraya District

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Abstract

This study aims to develop an E-Module based on problem-based learning using material related to the Human Respiratory System. This study uses quantitative and qualitative methods. This study is a development research project (Research and Development) utilising the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). To test the validity of the E-Module product based on problem-based learning (PBL) development, it requires two media experts, two language experts, and two design experts. The results of the study indicate that the validation process of the e-module based on Problem-Based Learning, using material on human respiration, to improve students' creative thinking skills yielded "very decent" results. Therefore, it can be said that this product is very suitable for use as a teaching material in learning about the human respiratory system in science. This problem-based learning E-module also received a very positive response from all research subjects, as evidenced by both teacher and student assessments. It can be concluded that the researcher has developed an E-Module that aligns with the research objectives.

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1. Introduction

The Indonesian curriculum, specifically the 2013 curriculum, is designed to promote student-centred learning by focusing on three key areas: attitudes, knowledge, and skills (Widiarta et al., 2020). Natural science, being the cornerstone of technological advancement, plays an essential role in students' education. Early exposure to natural science, particularly in elementary education, is crucial for developing the necessary attitudes, skills, and knowledge that enable students to adapt to an ever-evolving world (Yustanti, 2022). However, students often face difficulties in understanding scientific concepts due to traditional, one-way teaching methods that limit engagement and critical thinking. This challenge is further compounded by the insufficient incorporation of interactive learning experiences, particularly in subjects such as the human respiratory system.

At UPT SDN 11 Tiumang, Dharmasraya Regency, teachers face several challenges in teaching science, especially regarding foundational concepts such as the human respiratory system. These challenges include limited textbooks, complex language, and a lack of interactive learning resources, all of which hinder students' comprehension and understanding. Additionally, the absence of realistic models or analogies makes abstract concepts even more difficult to understand. Traditional methods, such as lectures and written assignments, often fail to support students' understanding of science topics adequately. To address these issues, there is a pressing need to adopt innovative teaching methods and resources, such as e-modules, which can provide a more engaging and effective learning experience.

E-modules, particularly those designed using the Problem-Based Learning (PBL) approach, offer significant advantages in science education. According to Asrar et al. (2023), e-modules, with their interactive features such as videos, audio, and graphics, can enhance student engagement and motivation. Sutanto (2020) asserts that PBL-based e-modules help students more effectively absorb learning materials, track their progress, and engage in collaborative problem-solving. The dynamic nature of e-modules offers a departure from traditional print materials, providing a more engaging and comprehensive learning environment. By utilizing e-modules, students are better able to retain information and develop critical thinking skills, particularly in scientific subjects.

The development of e-modules based on PBL for teaching the human respiratory system to fifth-grade students at UPT SDN 11 Tiumang is expected to address the current challenges in teaching and learning. By integrating multimedia elements and problem-solving activities, these e-modules will offer a more interactive and effective learning experience. This approach not only aids students in understanding complex scientific concepts but also encourages collaborative learning and the development of essential 21st-century skills. Therefore, the incorporation of e-modules into the science curriculum is likely to significantly improve student learning outcomes and foster a more interactive, student-centred educational environment.

2. Literature Review

2.1 Development

The purpose of development is to use systematic and organized learning planning to explain every aspect of learning. This process considers the potential and skills of students. Development, as defined by Risdiany (2021:65), is the process of developing and refining a product, which includes researching to gain a deeper understanding of the product. Development is an effort to improve moral, theoretical, technical, and contextual skills according to the demands of the time through education and training, as claimed by Waruwu (2024:220). In addition, development should not be used to test concepts, but to produce products that are useful for teaching (Rustamana et al., 2024:26). This applies to both research and teaching methods.

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Researchers can conclude that development is the process of creating new or improving existing products with the aim of refining them, including field testing and validation, based on the opinions of these specialists. The product is further refined to produce a superior final product after field testing.

2.2 E-Module

According to Erawati et al. (2022:87), computer software that displays images, graphics, text, and videos to help students evaluate and integrate their learning levels is referred to as an E-module. Muryati et al. (2023:29) stated that the E-module is a powerful and effective digital learning tool that helps students solve their problems using music, video, and graphics.

Elvarita et al. (2020:3) stated that e-modules are learning tools that include systematic methods, materials, and assessments to help students achieve competency goals based on their level of complexity. In line with this view, Febdhizawati et al. (2023:18) emphasised that electronic modules, or E-Modules, are one of the publicly accessible tools that can increase students' learning motivation while being imaginative and interesting. Thus, e-modules can be defined as learning modules designed to facilitate the teaching and learning process by providing innovative, systematic, and organised learning resources, making it easier for teachers to provide instructions and for students to learn.

2.3 Problem-based learning (PBL)

The problem-based learning (PBL) paradigm requires original research, which is defined as studies that seek real solutions to real-world problems. Problem-based learning (PBL) strategies engage students in active learning while providing instructor supervision in discovering related concepts. As mentioned. Students who use a "problem-based learning" approach to their education can benefit from a meaningful educational experience. To increase student success, PBL encourages students to apply what they have learned to solve real-world problems. Their experiences can be used as reading materials, guides, learning objectives, and strategies. In addition, Ii et al. (2020:78) define problem-based learning as a student-centred teaching and learning approach that involves research, integrates theory and practice, and utilises knowledge and skills to provide appropriate solutions to problems.

The thoughts of these experts suggest that the problem-based learning model is a novel approach to teaching that enables students to learn actively by solving contextual problems, thereby gaining a deeper understanding of the material being discussed.

2.3 E-Module based on problem-based learning (PBL)

PBL-based e-modules are digital learning resources that integrate text, images, videos, and interactive questions, requiring students to engage in problem-solving. These modules can be accessed on computers or mobile phones, providing flexibility in learning and easy dissemination via digital platforms. To enhance the learning experience, PBL e-modules combine traditional digital content with multimedia elements, offering a dynamic approach to education. According to Sartika (2024:16), Problem-Based Learning (PBL) is a teaching strategy that encourages students to apply critical thinking skills to address real-world issues. The primary goal of PBL is to foster the development of critical thinking, problem-solving abilities, self-regulation, and self-confidence in students. Through this student-centred approach, PBL helps learners expand their knowledge by guiding them in solving complex, contemporary problems.

Furthermore, by exposing students to real-world problems, the PBL paradigm enhances their understanding, as claimed by Musaad & Suparma (2023:29). Additionally, by presenting unstructured scenarios, the unique teaching method can help students hone their critical thinking

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skills. According to experts' perspectives, learning models can help students build their own knowledge and reasoning skills by teaching them how to handle truly student-centred problems.

3. Method

This study uses a combination of qualitative and quantitative methodologies. The development model used is the ADDIE model. This research was conducted at UPT SDN 11 Tiumang. This research was conducted from January 2025 to the end of the even semester of the 2025 academic year. The data sources for this project were provided by six validators, comprising two material experts, two language experts, and two design experts. For the purposes of collecting secondary data in this study, relevant books, articles, journals, and websites have been consulted. The subjects of the study were teachers and students of UPT V SDN 11 Tiumang. Two media experts, two language experts, and two design experts were needed to test the validity of the E-Module product based on problem-based learning (PBL). Research data were collected through interviews and questionnaires. Qualitative and quantitative data analysis were included in the data analysis process.

4. Results

4.1 Analysis stage

The results from the e-Module teacher needs analysis questionnaire revealed that most educators believe the current learning resources are inadequate in supporting students' independent learning. This lack of effective resources limits students' ability to engage in self-directed learning outside of the classroom. While PowerPoint presentations are commonly used by teachers, most still rely heavily on printed textbooks without making additional efforts to enrich the learning experience. This traditional approach to education is problematic as it does not foster more effective student learning or encourage a student-centred learning process.

In response, the researcher introduced examples of open-source digital resources for science education, encouraging educators to experiment with these materials. The digital teaching resources included various elements such as learning objectives, instructional resources, educational films, interactive simulations, and application evaluations. Teachers were enthusiastic about exploring these open resources, as they recognised the potential benefits that they offered. Educators generally agree that integrating digital and interactive teaching resources is essential to enhancing student engagement and performance in science education. According to Sari & Atmojo (2021), the effective use of digital teaching resources can help bridge the gap between the nature of science content and the 21st-century skills required, creating a more harmonious and effective learning environment. Students in grade V of elementary school were analysed between the ages of 10 and 11 years. According to Jean Piaget's theory of child development, this indicates that children are in the concrete operational stage of cognitive development. This stage typically occurs during elementary school, when the age range is approximately 7 to 11 years.

At the concrete operational stage, fifth-grade students at UPT SDN 11 Tiumang, Dharmasraya Regency, based on student analysis, began to master a more rational, methodical, and structured thinking process. Fifth-grade students must be able to experience learning through concrete events and activities, as well as real-world experiences. Technology-based learning is engaging for students and can be effectively utilised. The interactive e-modules needed by students are not yet available to educators. In elementary school learning, researchers can provide concrete learning tools, such as electronic modules, tailored to individual needs.

In the learning process, curriculum analysis acts as a guideline. An independent curriculum has been implemented in Grade V at UPT SDN 11 Tiumang, Dharmasraya Regency. The government still provides the primary open teaching materials in the form of textbooks. The purpose of curriculum analysis is to determine the breadth of content in relation to predetermined learning objectives and learning outcomes. The selection of material on the human respiratory system aligns with the elements of the problem-based learning approach, which requires students to provide answers about the human respiratory system and how to maintain it.

4.2 Design stage

The researcher began by creating a flowchart as part of the e-module design process for the human respiratory system. The e-module was developed using the flowchart as a guide or standard. Indications of the human respiratory system learning materials were incorporated into the flowchart design. Resources were collected based on their content, which included text, images, and videos. Additionally, sources of books or texts that would be included in the e-module being developed were identified.

Additionally, it will be converted into a storyboard, which serves as the first blueprint for creating an e-module on the human respiratory system, thereby increasing students' capacity for original thinking. The researcher developed a prototype as the first concept for an interactive e-Module product. This is the original design of an interactive e-module.

Figure 1. Design of an interactive e-module

4.3 Development and implementation stage

The final product developed is an e-module on the human respiratory system, designed for use on both laptops and Android devices. The product, created using Canva, includes essential components such as the cover, identity, basic competencies, learning objectives, materials, evaluations, exercises, bibliographies, and summaries. Canva's features allowed for the integration of various media types, including text and images, into a format compatible with both Android devices and desktops. The e-module was validated by media and materials experts through a questionnaire that gathered their feedback and suggestions. These inputs were incorporated to refine the product, ensuring its suitability for testing. The design validation process involved

reviewing open-ended materials and evaluating media by a media specialist, and the validation findings were used to make further improvements.

To ensure the quality of the e-module, two design experts, ZA and LT (a teacher at UPT SDN 11 Tiumang, Dharmasraya Regency), were selected for validation. After conducting the assessment, the validation results were summarized and analyzed to refine the e-module. The media validation questionnaire yielded scores ranging from 51.3 to 63.3, with an average score of 55 and a percentage of 92.7%, indicating a "Very Good" category. Despite this, the e-module was still considered feasible, and the researcher made revisions based on the experts' recommendations. These suggestions included displaying the author's name on the second cover page and allowing flexibility in writing style. The adjustments, as reflected in the revised design shown in Figure 2, further enhanced the e-module's suitability for educational use.

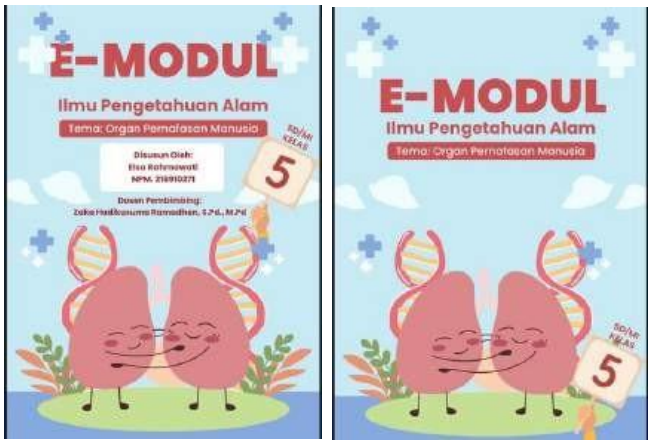

Figure 2. Initial view before and after revision

The validator with the initials ZA revised the first validation, namely, the cover was divided into two parts (outer cover and inner cover). The cover before the revision included the names of the researcher and the supervisor, and the class identity section was placed above the main title of the module. After receiving input and recommendations, the researcher made the changes shown in Figure 2, specifically placing the class identity under the cover and retaining only the main title. Meanwhile, the inner cover included the names of the supervisor and the researcher. After the design expert revised it, the researcher returned to refine the second stage of the project.

The relevance of the material to the explanation in the E-module was evaluated in this validation. After reviewing and analyzing the content of the researcher's e-module, the material expert used a questionnaire to evaluate the content created by the researcher. S and YP conducted the validation. Based on the validation questionnaire by material experts with reference to the total score of 115 scores in the "Feasible" category, with an average of 95.7 and a percentage of 97.4% and 93.9%, obtained from the validation of the questionnaire by material experts based on the total score, which was then collected. After initial validation by material experts, the researchers made changes based on their recommendations, indicating that the human digestive system electronic module was "feasible" for use with modifications according to their recommendations for testing.

Based on the examination of the linguist questionnaire in Table 8, 110 scores were obtained, with an average of 92.7% and a percentage of 92.7% in the range of 90–100, which falls within the "Very Good" group. Based on the linguist's validation results, this electronic module for the human respiratory system is highly suitable for use without amendment testing.

The percentage of results from the teacher assessment questionnaire that fell into the "Very Good" category was 91.7%. According to the teacher questionnaire, the e-module content was easy

for students to understand and presented in an interesting manner. The module also used high-quality visuals to help students develop their creative thinking skills. Additionally, students were invited to participate in small-group trials by the remaining teachers.

Students participated in a small-group product trial to assess their reactions to the human digestive system electronic module after receiving feedback from the teacher. Each student received the merchandise as a link on their Android or smartphone. The researcher provided instructions on how to use the electronic module before opening the link. After this, the researcher asked the students to view and evaluate the content in the electronic module. Each student was then given a questionnaire to assess their feelings about the resulting electronic module. Students gave positive responses to the designed e-module, as seen in Table 10. Since students gave good responses to the researcher's e-module on problem-based learning, it can be concluded that the e-module is practical and can be useful for students in understanding the material on the human digestive system

5. Discussion

Before being tested in the field, the previously prepared e-module was validated by experts in design, materials, and language. The final product of this teaching material's development is an e-module based on Problem-Based Learning, accessible via laptop, computer, or smartphone, which enhances students' creative thinking capacity in the context of the Human Digestive System. The E-module consists of the front cover, instructions for use, competencies, indications, and learning objectives. In addition, the sequence, assessment, and synopsis of the Human Respiratory System content. The last part of the E-module includes the developer's profile and a list of references.

The e-module is designed to look more attractive by utilising various colours, fonts, and font sizes. The structure of this e-module follows the Problem-Based Learning model. The goal is to encourage students to address current issues by honing their creative thinking skills to improve their conceptual understanding. The development research at UPT SDN 11 Tiumang, Dharmasraya Regency, is based on student answers with a score above 90% (very good) and instructor response surveys. Data is considered very good if it produces a percentage between 81 and 100, as stated by Riduwan (2019).

The analysis was conducted by researchers who also examined learning objectives, learning problems, learners, and learning environments. The results of the researchers' interviews with grade V teachers at UPT SDN 11 Tiumang, Dharmasraya Regency, explain why instructors often use printed books and basic practices as learning resources. Because the school has not determined what types of media students may use during the learning process, open teaching materials in the form of e-modules have never been utilised.

Observation results indicate that approximately half of the students continue to struggle with absorbing the material, and less engaging teaching materials are a contributing factor to their difficulties. E-modules are one type of learning media that is created in accordance with the learning objectives of teachers and students. Students can access this e-module via their Android devices, allowing them to learn anytime and anywhere, outside of class. Thus, it is hoped that the creation of this e-module will help educators in the teaching and learning process, making it easier for students to learn and better understand the material. Based on these findings, which are consistent with previous studies, e-modules are effective in increasing student engagement and motivation in class, thereby improving learning outcomes (Hastari, 2019:22). E-modules have the potential to enhance student learning outcomes, enabling them to contribute to the improvement of the education process (Wirawan, 2019:29).

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The purpose of this development research is to provide e-modules to students, enabling them to learn independently. It can be concluded that teachers can utilise e-modules that focus on problem-based learning about the human respiratory system to help students develop their creative thinking skills as an additional learning resource. E-modules are interactive, allowing the display of tested images, texts, and videos and automatically providing feedback (Diantari et al., 2018; Sugihartini & Laba, 2019:78). If the design and style of the E-module are attractive and include video or animation components, students will be interested, and their motivation, enthusiasm, and creativity will increase.

The PBL-based E-module product obtained a very good qualification based on the evaluation results given by design experts. A number of factors contributed to the very good qualification, including: (1) accuracy and readability of the text; (2) suitability of images to learning content; (3) E-module learning videos; and (4) ease of use of the E-module. According to Sudarma et al. (2019:55), students can receive messages effectively when the text is both appropriate and readable, as the sense of sight can process it easily.

The PBL-based E-module product obtained a very good qualification based on the evaluation results given by the material experts. Several factors that caused the very good qualification include: (1) identification, indicators, and learning objectives of the E-module are clear; (2) the systematics, content, and depth of the material presented in the E-module are appropriate; (3) the language used is appropriate, the material is clear, the content is easy to understand, and (4) the evaluation questions are formulated clearly and at the right level of difficulty.

Based on the results of the diagram above, the assessments of validators 1 and 2 yielded percentages of 90.00% and 90.00%, respectively. This demonstrates that the content of the E-module provided by the researcher is suitable and in line with the Problem-Based Learning learning model. To enable students to achieve increased learning outcomes. This product obtained an excellent qualification based on the evaluation results given by language specialists for PBL-based E-module products. The grammar developed by E-Module researchers remained unchanged and was in accordance with the EYD. Only one validation was conducted.

The qualifications are very good, based on the results of the large and small group trial evaluations. Several factors that cause this very good quality include: (1) ease of use of the E-module; (2) attractive appearance; and (4) communicative language used in the content presented. This finding aligns with the research of Diantari et al. (2019), who found that students would feel more comfortable accessing learning materials independently if the E-module were easy to use. Communicative language can make it easier for students to understand learning materials, and an attractive display of learning media can inspire students to engage with their learning. Based on his research, Ahsan (2019:65) explains how electronic learning media can be used more successfully in teaching and learning activities than traditional classroom learning.

6. Conclusion and Implications

Based on the results of research and discussion on the use of problem-based learning e-modules on the human respiratory system material to improve students' creative thinking skills, it can be said that: The ADDIE model, consisting of the following steps: (1) needs analysis; (2) design; and (3) development and implementation, which includes expert validation and teacher and student feedback, was used to develop a problem-based learning e-module on the human respiratory system material to improve students' creative thinking skills. Canva was used to develop the e-module, and the learning outcome test was part of the evaluation process. The human respiratory e-module, which utilises problem-based learning to enhance students' creative thinking skills, achieved a "very good" result from the validation procedure. Thus, it can be concluded that this

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project is highly feasible for use as an open-source teaching material on the human respiratory system in science education. In terms of teacher and student assessments, this problem-based learning e-module also received very good feedback from all research participants. It can be said that the researcher has developed an e-module that aligns with the research objectives.

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