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DEVELOPING E-MODULE ON IDENTIFICATION OF THE *Schistosoma japonicum* EGG'S IN HUMAN FECES, NORTH LORE DISTRICT, |CENTRAL SULAWESI

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ABSTRACT

The integration of digital technology in education is rapidly growing. However, the application of this technology in learning can be inconsistent. There is limited literature on Schistosomiasis among students, leading to a lack of understanding of the disease. This study aimed to develop a valid, practical, and effective e-module for identifying Schistosoma japonicum worm eggs in human feces in the North Lore District of Central Sulawesi. The ADDIE model was utilized for the module's development, which involved the stages of needs analysis, design, development, implementation, and evaluation. The media and material validity tests yielded highly valid results. The module was assessed as highly practical for use in teaching. Additionally, the effectiveness of the media was determined to be very high, with an N-gain test score of 0.76, indicating a significant level of learning. Based on these findings, the e-module is considered valid, practical, and effective for biology education. This study is expected to serve as a reference for future researchers developing similar products in other biology subjects.

INTRODUCTION

The era of Industry 4.0 will directly impact the education sector. Alwi et al. (2020) explain that the education era influenced by the Industrial Revolution 4.0 is characterized by the use of digital technology in the learning process, known as the cyber system, which enables continuous learning without the limits of space and time. Electronic modules or e-modules are presentations of information in the form of independent learning materials systematically arranged into the minor learning units to achieve specific learning goals, presented in book format electronically using hard disks, diskettes, CDs, or flash drives,

and can be read using computers or e-book readers. E-modules serve as media that can deliver images, videos, and animations to enhance students' understanding (Prasetyo, 2020).

Based on observations made in one of the animal taxonomy courses conducted in the 5th semester of the 2023/2024 academic year, teaching materials were developed. This is because the teaching materials used by lecturers and students so far have been limited to PowerPoint. The PowerPoint presentations used are considered ordinary due to students' and educators' lack of creativity, even though they have been combined with audio, visual, and other elements. Moreover, PowerPoint is less effective in stimulating students' activity and creativity. Therefore, learning can become more effective by developing teaching materials. One form of teaching material that can increase students' interest in education is the e-module. In this research, the development of the e-module is based on research results on identifying *Schistosoma japonicum* eggs. *Schistosoma japonicum* is part of the phylum Platyhelminthes, class Trematoda, studied in the animal taxonomy course in the Biology Education study program.

The reason for developing an e-module based on research results on identifying *Schistosoma japonicum* eggs is that this worm is an endemic parasitic worm in Indonesia. Currently, its known distribution is only in Central Sulawesi. According to WHO (2020), schistosomiasis is one of the neglected tropical diseases. Schistosomiasis is endemic in 78 countries and infects more than 229 million people in tropical and subtropical regions. *Schistosoma japonicum* infection can cause Katayama fever, liver fibrosis, liver cirrhosis, portal hypertension, splenomegaly, and ascites in chronic diseases. Some eggs can pass through the liver and lungs, the nervous system, and other organs, which can affect the infected individual's health. Central Sulawesi is the only province among Indonesia's 34 provinces endemic to schistosomiasis. This disease is present in 2 out of the 13 districts/cities in Central Sulawesi, namely Sigi District and Poso District (Central Sulawesi Provincial Health Office, 2020).

The presence of eggs in feces indicates the existence of adult *Schistosoma japonicum* worms in a person's body, leading to treatment for schistosomiasis. The lack of information about this disease is due to limited library sources. Therefore, developing teaching materials in the form of an e-module as an information source for students and

the general public about *Schistosoma japonicum* worms is essential. These teaching materials can be used in the learning process in the Animal Taxonomy course.

MATERIALS AND METHODS

This study employed a Research and Development (R&D) methodology to develop a new product: an e-module for identifying *Schistosoma japonicum* worm eggs in human feces. As outlined by Junitasari et al. (2021), the ADDIE model guided the product development process, encompassing analysis, design, development, implementation, and evaluation. Research on identifying *Schistosoma japonicum* worm eggs was conducted at the Wuasa Village Laboratory in North Lore District from October 2023 to completion. The study subjects consisted of fecal samples from individuals infected with *Schistosoma japonicum*. The data obtained in identifying will then be processed through statistical tests using ANOVA.

Furthermore, the technique used in implementing research and development (R&D) uses two types of data collected: 1. Qualitative data is in the form of descriptions or narratives of success that have been tested. 2. Quantitative data, namely data processing using numerical formulation. Student assessment questionnaire scores and validator assessments are used to obtain quantitative data. The questionnaire is for students who have taken part in product trial implementation. The expert validation questionnaire regarding presentation, graphics, language, content alignment, and the appropriateness of the Exe-learning-based electronic module offers four answer options based on the question content. The scoring for each answer choice is shown in Table 1.

Table 1. Expert Validation Scoring

Score	Answer Choices for Feasibility:
4	Very interesting
3	Interesting
2	Fairly interesting
1	Less interesting

The scores from each expert validator in media, content, and language are then averaged and converted into questions to determine the validity and feasibility of the developed media. Table 2 shows the conversion of scores into evaluation questions.

Table 2. Criteria Validation

Score	Feasibility Criteria	Notes
$3,26 \leq x \leq 4,00$	Valid	No revision,
$2,51 \leq x \leq 3,26$	Fairly valid	Partial revision,
$1,76 \leq x \leq 2,51$	Less valid	Partial revision and review of content
$1,00 \leq x \leq 1,76$	No valid	Overall revision

Analysis of the module's effectiveness using the N-gain test to determine the improvement between the pretest and posttest. The magnitude of the improvement is calculated using the normalized N-gain formulas. After obtaining the N-gain formula, it is interpreted according to the following criteria: if N-gain < 0.7, it is considered low, and if N-gain > 0.7, it is considered high.

RESULTS AND DISCUSSION

This research results in an e-module product identifying *Schistosoma japonicum* eggs in human feces in Lore Utara district, central Sulawesi. The results were obtained using the ADDIE R&D model, which consists of analysis, design, development, implementation, and evaluation.

Analysis

The objective of the analysis stage is to determine the problem that serves as the foundation for developing the learning e-module. In this stage, the analysis includes a problem. It needs students' analysis regarding the learning e-module developed for the Animal Taxonomy course in the Biology Education Study Program, FKIP, Universitas Tadulako. This analysis was carried out using surveys/questionnaires distributed to students from the 2020 cohort who were enrolled in the Animal Development course for the 2023 academic year.

Table 3. Results of the Student Needs Questionnaire Analysis

No	Question	Answer
1	What is your opinion on learning the Animal Taxonomy course, especially on the Platyhelminthes class (Blood fluke class)?	Very Important
2	What teaching materials and learning resources have been used in the Animal Taxonomy course so far?	Printed books and PowerPoint
3	What is your opinion on the teaching materials and learning resources used in the Animal Taxonomy course?	Quite helpful

No	Question	Answer
4	Have you studied the Blood Fluke class in the Animal Taxonomy course during the COVID-19 pandemic?	Yes
5	What kind of teaching materials do you want?	Materials that can be accessed anytime and anywhere, with clear explanations and learning instructions.
6	Which topics are difficult to learn in the Animal Taxonomy course?	Parasitology and Animals
7	How important is teaching material in the form of an e-module for learning the blood fluke class?	Very important

Based on the results of the student needs survey that has been distributed, it can be concluded that in learning animal taxonomy, particularly the Platyhelminthes material from the blood fluke class, students feel that teaching materials and learning resources that are accessible anytime and anywhere and engaging, such as e-modules, are very important and necessary in the learning process.

Design

In this design phase, the researcher creates an initial draft of the e-module product tailored to the needs of the students. The content of the e-module design consists of a foreword, table of contents, introduction, description, prerequisites, instructions for using the e-module, competency objectives, ability checks, material discussion, activities, independent assignments, and a bibliography. The product is designed using *Canva* and shared with *the Flipbook* application. The material in this e-module results from a literature review, namely scientific articles, books, research results, and case studies regarding the *Schistosoma japonicum* worm. More detailed product design results can be seen in the image below.

Figure 1. Design Cover e-module Identification *of* The *Schistosoma japonicum* Egg's In Human Feces, North Lore District, Central Sulawesi

Figure 2. Design Foreword and Table e-module

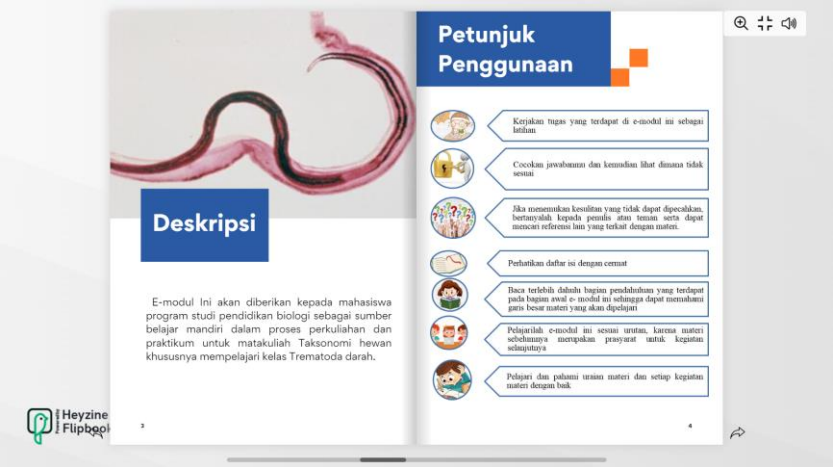

Figure 3. Design Description and Instructions for Use e-module

Figure 4. Design e-module Life Cycle and Characteristics of *Schistosoma japonicum* Egg's In Human Feces, North Lore District, Central Sulawesi

Figure 5. Design Activity e-module Identification *of* The *Schistosoma japonicum* Egg's In Human Feces, North Lore District, Central Sulawesi

Development

The next stage is the development of the e-module, which aims to obtain the validity of the teaching materials being developed. The product that has been designed is then given to validators to receive feedback and suggestions for product improvements, including content and design. The validators are divided into content, media, and design experts, using an e-module feasibility research instrument.

Based on the validation results from the design expert, for the category of material explanation, the score obtained was 15 out of a maximum score of 20, resulting in a design validation percentage for the material explanation category of 75%. For the image and video category, the score obtained was 12 out of a maximum score of 15, resulting in a design expert validation percentage for the image category of 80%. For the image caption text category, the score obtained was 16 out of a maximum score of 20, resulting in a design expert validation percentage for the image caption text category of 80%. Based on these three categories in the design expert validation test, it can be concluded that the e-module is suitable for use.

In the validation results from the media expert, the title category received a score of 16 out of a maximum score of 20. The percentage shows that the media validation test for the title category is 80%. For the material category in the e-module validation test by the media expert, the score obtained was 18 out of a maximum score of 25. The percentage obtained for the material category in the media expert validation test is 72%. Based on the media expert's validation results of both categories, it can be concluded that the e-module is suitable for use.

Implementation

The implementation stage involved testing the developed module on 5th-semester Biology Education Study Program students, Faculty of Teacher Training and Education, Tadulako University, who were taking the Animal Taxonomy course. At this stage, students were given a questionnaire containing eight questions. The responses from the questionnaire were used to obtain data in the form of pre-test and post-test scores.

Based on the students' responses, the highest score was obtained for the attractiveness of the e-module content, 4.59. The lowest score was in the category of the module's image display, 4.32. The average score from all student responses was 4.43 out of a maximum score of 5.00. The percentage obtained based on student responses to the learning module was 89%. This percentage indicates that the e-module is highly suitable for use.

Evaluation

The final stage of this e-module development is to conduct a formative evaluation to assess the module's suitability for students studying animal taxonomy. The success of this e-module development is measured based on student feedback through pre-test and post-test scores. The figure below provides a more detailed breakdown of the pre-test and post-test scores.

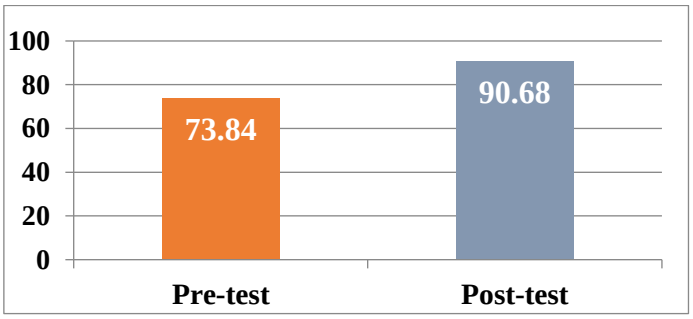

Figure 6. Pretest and Posttest Scores

The N-gain test was performed using SPSS software to analyze the improvement between the pre-test and post-test results.

Tabel 4. The Results of the N-gain Analysis

		Correlation	*N*	*Significant*
Pair 1	Pretest - Posttest	0.200	18	0.76

Based on the N-gain calculation, a score of 0.76 was obtained, which falls into the high category. This indicates that the e-module for learning the identification of

Schistosoma japonicum eggs in human feces is efficacious in improving students' understanding and is suitable for use.

The learning e-module, commonly known as the Electronic Learning Module, is a teaching material that can be accessed via computers or mobile phones, supporting the learning process through designs using software tailored to specific needs. The e-module is a learning tool or medium containing materials, methods, guidelines, and evaluation methods systematically and attractively designed to achieve the expected competencies according to its complexity level in electronic format. According to Zainal (2019), electronic modules are learning materials that help students learn subject matter independently using electronic media. Lastri (2023) and Widiana & Rosy (2021) stated that various electronic modules are available in formats such as .pdf, .doc, .swf, .html, .lit, and others.

Students' current needs must be met with suitable teaching materials to support the learning process. Therefore, the use of learning e-modules is essential. This is in line with the benefits of developing e-modules as outlined by Anwar (2023) and Fujiarti et al. (2024), which are: e-modules train independence (self-instructional), better adapt to the characteristics and developments of science and technology (adaptive), are flexible to use anytime and anywhere, and prioritize user comfort (user-friendly).

The ADDIE model is used as the development model for the learning e-module in identifying *Schistosoma japonicum* egg, consisting of several stages: analysis, design, development, implementation, and evaluation. The first stage is analysis, where research was conducted to analyze the students' needs regarding the teaching material for platyhelminths, specifically blood trematodes, which became the basis for developing the e-module. Based on the analysis results from a questionnaire with seven questions, there was a need for practical and accessible teaching materials. Therefore, students required a helpful module with clear explanations and instructions that could be accessed anytime and anywhere. In line with Damayanti & Perdana's (2023) opinion, the advantage of e-modules in the learning process is that they increase flexibility and effectiveness, as they are not limited by space and time.

Moreover, e-modules have the potential to enhance students' thinking abilities as the information is laid out in a structured and in-depth manner. This helps students understand the concepts or topics studied, enabling them to learn independently and

flexibly, especially in choosing their own study time and pace according to individual characteristics. The e-module is designed with various displays such as text, animation, images, and videos, which can increase student engagement and interactive learning according to technological developments (Hardanti et al., 2024; Tahmid et al., 2024). Furthermore, Sova et al. (2022) stated that Information and Communication Technology (ICT) plays an important role in education, particularly in learning. Various ICT solutions have proven to improve educational services and learning. One of the popular ICT solutions is online learning or e-learning.

The second stage is design. Based on the needs analysis, the next step is designing the e-module tailored to the student's needs. The planning includes components of the e-module, such as an introduction, table of contents, preface, materials and activities (theoretical background, work procedures, independent tasks), and references. The third stage is development, where experts validate the developed product's feasibility, including subject matter experts, media experts, and language experts. The experts validating the teaching materials are lecturers from the Graduate School of Tadulako University. Sakdiah et al. (2023) mentioned that validation results are material for revisions and evaluation based on expert feedback. Based on the assessment by three validators, including media, content, and design experts, the title was rated at 80% and the material at 72%, both classified as feasible. The average score was broken down based on the achievement of each aspect. The content aspect of the e-module achieved 73.3% and was classified as feasible. For content validation, the material description was rated at 75%, images and videos at 80%, and explanatory text at 80%. Based on these scores, the e-module design was classified as feasible. Additionally, the student's responses to the e-module on *Schistosoma japonicum* egg identification in human feces were classified as very good, with an average score of 89%. The fourth stage, after development, is implementation. Once the experts have validated the e-module, it is given to students for an online trial. The students receive a link to the e-module with instructions provided within it. After learning, students complete independent tasks and fill out a response questionnaire. Based on the student's independent tasks, the module's effectiveness was analyzed using the N-gain test, which indicated a high category ($g > 0.7$) with a score of 0.76.

The results of the implementation phase indicated that the module is feasible for use as teaching material. Therefore, the fifth stage, evaluation, was carried out. At this stage, revisions and improvements were made based on feedback from various parties, including media experts, content experts, design experts, and students. The success of the e-module development was measured by student feedback collected through questionnaires. The evaluation results concluded that the e-module on identifying *Schistosoma japonicum* eggs in human feces in Lore Utara District is feasible for use. This conclusion was supported by the results of the questionnaire trial and independent task answers, both showing positive outcomes.

CONCLUSION

Based on the results and discussion above, it can be concluded that the developed product, an e-module on the Identification of the *Schistosoma japonicum* egg In Human Feces, North Lore District, Central Sulawesi, is valid, practical, feasible, and effective as a learning material in the animal taxonomy course.

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Future developments for the e-module could include more diverse interactive features such as egg identification simulations and online discussion forums. Furthermore, the e-module could be disseminated to other educational institutions. A mobile app version could also be developed to enhance accessibility and usability.

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