DEVELOPMENT OF WEBSITE-BASED E-MODULE LEARNING MEDIA TO IMPROVE STUDENTS SCIENCE LITERACY ON EXCRETORY SYSTEM MATERIAL

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Abstract: The current level of science literacy of students still tends to be low, this happens because of the limited learning media used in the learning process. The existence of learning media can be used as a tool in stimulating students thoughts, attention and abilities. This study aims to develop learning media in the form of website-based e-module that are feasible, effective and practical in improving students science literacy in excretory system material. The method used in this research is Research and Development (R&D) with the ADDIE development model. This research was conducted at Taruna Terpadu High School and aimed at class XI MIPA with a total of 25 students and involved 2 biology teachers. The research design was in the form of one group pretest-posttest or using one class as an experimental class. Before being tested, the e-module was validated by media experts and material experts. The results of the assessment by media experts obtained a percentage of 100% with very feasible criteria, while the material experts obtained a percentage of 93% and 92.5% with very feasible criteria. Testing the effectiveness of e-module from the results of the N-gain calculation obtained a value of 0.73 with high criteria. After being tested, practicality testing was carried out through students and teacher response questionnaires. The teacher response questionnaire obtained a percentage of 99.5% with very practical criteria. While the students response questionnaire obtained a percentage of 90% with very practical criteria. The existence of interactive web-based e-module can increase students motivation and learning independence and increase understanding of science concepts by reading, understanding and analyzing science information critically. Based on the results of the study, it can be concluded that the website-based e-module developed is feasible, effective and practical in improving students science literacy on excretory system material.

Keywords: E-module based website; scientific literacy; excretory system

INTRODUCTION

The development of science that occurs today cannot be separated from technological advances. Technological advances bring rapid changes to various fields of life, especially in the field of education (Rilanty & Tita, 2020). Education is the main key in improving the quality of a nation. The quality of education in a nation is one of the determinants of the nation's progress (Kurniawati, 2022). The

use of technology in the field of education needs to be used especially in learning activities. This is because technology has an important role in helping teachers during the learning process. The utilization of technology as a learning media is one of the efforts to improve the quality of learning so that the material delivered by the teacher is better understood by students.

Based on data obtained from the Program for International Student Assessment (PISA) in 2018, Indonesia ranked 62nd out of 70 countries with low literacy levels including reading, mathematics and science skills (Fuadi et al., 2020). The low level of science literacy of students in Indonesia requires efforts to improve science literacy through learning that can be applied with the use of technology. Technology plays an important role in learning in schools that can encourage students to learn science (Taştan et al., 2018). Science literacy provides an opportunity for someone to take part in understanding and solving a problem related to science and technology that plays an important role in everyday life (Rifqi, 2021).

Science literacy is defined as scientific knowledge and skills in terms of identifying a question, gaining new insights, explaining scientific phenomena, and drawing conclusions based on facts (PISA, 2018). Biology is a science-centered subject so there needs to be science literacy skills that need to be achieved by students (Nofiana & Teguh, 2018). In addition, biology is a subject that requires the scientific method in its learning. This requires students science literacy skills because it can affect learning outcomes in biology learning. Basically, biology subjects contain abstract material, so learning media is needed that can present abstract concepts to be concrete such as e-module learning media.

Based on the results of preliminary tests that have been carried out at Taruna Terpadu High School in class XII MIPA 8, information was obtained that 92.6% of students have never used e-module as biology learning media. This is because the biology learning media used is less varied, only sourced from textbooks as students handbooks. As many as 77.8% of students have difficulty in understanding the material using the package book. Students prefer learning media that is attractively packaged, presents interactive learning images and videos with a percentage of 92.6% students need electronic learning media in supporting biology learning. This is because the learning resources used during biology learning are only in the form of textbooks from schools so that students understanding is only limited to textbooks.

Electronic module or commonly abbreviated as e-module is one of the electronically packaged learning media that can be accessed anywhere and anytime when needed. E-module are module in electronic form, consisting of text, images, or both that contain material accompanied by simulations that can and should be used for learning. E-module are also defined as learning resources that contain

material, methods, limitations and ways to evaluate which are systematically designed and attractive in electronic form to achieve competencies in accordance with the curriculum and the learning objectives achieved (Laili et al., 2019). While website-based e-module refer to electronic learning content or learning module presented through a platform or website. According to Karnando & Sugiarti (2023), website-based e-module are defined as a collaboration between material and technology in a unit to support learning.

Excretory system material has characteristics that require an abstract level of thinking. This is because the material relates to the processes of excretion of waste substances that occur in the body such as the mechanism of urine formation that cannot be observed directly by students. Based on the results of preliminary tests that have been carried out at Taruna Terpadu High School in class XII MIPA 8, it is known that as many as 64.6% of students have difficulty in understanding excretory system material including the structure of excretory organs, the process of urine formation and disorders or disorders of the excretory system. The percentage of students science literacy in excretory system material is 62.4% which is classified as low. In this regard, learning media is needed in the form of e-modules that can improve science literacy in excretory system material. According to Sunami & Aslam (2021), e-module can improve science literacy and the quality of learning activities in the classroom, because they can be used as a tool that can accelerate the delivery of material in the learning process.

Based on the results of research by Roro Rastrani Rahada Putri et al., (2022), entitled "Development of Electronic Module Learning Media (E-Module) Based on Flip Pdf Professional on Human Blood Circulatory System Material Class XI SMA", it is known that flip pdf professional is software that converts pdf files into digital flipping pages. The professional flip pdf-based e-module developed has disadvantages such as the presence of advertisements every few minutes so that it interferes with the display of e-module content for readers. So that further website-based e-module development is needed that is interactive and can be accessed without any ad display. The research conducted by Andi (2023), entitled "Flipbook-Based Learning Media on Excretory System Material to Improve Science Literacy of Grade XI High School Students" shows that excretory system material is abstract biological material so that tools are needed in the form of digital learning media so that material can be channeled properly to students and can improve students science literacy. Based on this, it is necessary to develop learning media in the form of a website-based e-module on excretory system material that can increase motivation, students learning independence and understanding of science concepts by presenting interactive features in improving students science literacy.

The features contained in the website-based e-module developed in the form of bio fun fact and bio watch features represent aspects of explaining scientific

phenomena on indicators of applying scientific knowledge and applying science. While the bio discuss, bio exercise and bio lab features represent aspects of evaluating and designing scientific questions on indicators of identifying, distinguishing, exploring and evaluating questions given scientifically. The bio article, bio resume and bio task features represent aspects of interpreting data and evidence scientifically on indicators of identifying assumptions, analyzing and interpreting data, drawing conclusions and distinguishing and evaluating arguments and scientific evidence from various sources.

Based on these problems, this study aims to determine the characteristics of a feasible website-based e-module development design, produce effective and practical website-based e-module in improving students science literacy on excretory system material. The website-based e-module developed has advantages that distinguish it from other digital learning media, namely that the website is made privately so that there is no advertising display on the website-based e-module page. In addition, the website-based e-module can be accessed in life time without any time limit for access and is equipped with interactive features that can improve students science literacy on excretory system material.

METHOD

The method used in this research is Research and Development (R&D) with the ADDIE development model. The ADDIE development model consists of five stages, namely analysis, design, development, implementation, and evaluation (Hidayat & Nizar, 2021). At the analysis stage, researchers conducted interviews with biology teachers and students as well as observations to find out the learning process, students characteristics in learning, curriculum and learning media used as well as to analyze problems and needs in learning. Furthermore, at the design stage, researchers designed concepts and content in the process of making products, e-module were designed using the canva application and the visual studio code application to design websites.

At the development stage, the website-based e-module that has been compiled then validated by experts, namely 1 media expert and 2 material experts to determine the feasibility of the web-based e-module developed so that it can be revised and tested on students. While at the implementation stage, the website-based e-module that has been validated is then tested on a limited basis to students in class XI MIPA 6 at Taruna Terpadu High School. The implementation stage is carried out to determine the effectiveness of e-module in improving students science literacy in learning biology of excretory system material. As for the evaluation stage, researchers gave a response questionnaire to 2 biology teachers and 25 students on the use of website-based e-module during learning to find out the shortcomings, advantages and practicality of the e-module developed.

The ADDIE development model makes students the center of learning and can inspire students so it is appropriate to use in this study. In addition, the ADDIE development model is interactive between students and teachers (Hidayat & Nizar, 2021). This research was conducted at Taruna Terpadu High School from October 2023 to May 2024. The research design used was one group pretest-posttest using one class as the experimental class. Sampling was carried out using purposive sampling technique based on considerations regarding learning outcomes and literacy levels that tend to be low, the sample selected in this study was XI MIPA 6 class students with a total of 25 students.

The research instruments used were interview guidelines, preliminary test questionnaires, media validation questionnaires, materials and science literacy instruments, multiple choice tests and teacher and students response questionnaires. Media feasibility testing is addressed to computer science lecturers. While the feasibility of the material is addressed to biological science lecturers and biology teachers. The feasibility of science literacy instruments is addressed to lecturers of biology learning evaluation. The validation data obtained from media experts, materials and science literacy instruments covering aspects of feasibility and the results of teacher and students response questionnaires covering aspects of practicality are then presented to obtain a final percentage value related to the feasibility and practicality of e-module. Meanwhile, the effectiveness of the e-module was carried out using the N-gain test from the pretest and posttest results, the Shapiro Wilk normality test and the paired sample T-test parametric test. The test used the SPSS 26 application.

RESULTS AND DISCUSSION

The development of website-based e-module to improve students science literacy on excretory system material is carried out based on the ADDIE model which consists of five stages, namely analysis, design, development, implementation and evaluation as follows:

1. **Analysis Stage**

    The analysis stage was carried out by interviewing teachers and students, observing biology learning in class and filling out a questionnaire of students needs related to learning media at Taruna Terpadu High School. The analysis stage consists of:

    a. **Curriculum Analysis**

        The curriculum applied at school is the independent curriculum for grade X students and the 2013 curriculum for grade XI and XII students. The independent curriculum has one of the characteristics of focusing on essential materials (literacy and numeracy), students are expected to have better literacy and numeracy skills. Meanwhile, the 2013 curriculum has

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the characteristic of having core competencies which are divided into several aspects, namely attitudes, knowledge, and skills that must be learned by students. Students are expected to connect various disciplines, foster creativity and broad insight. The application of the 2013 curriculum to grade XI students in learning biology excretory system material is contained in basic competencies 3.9 and 4.9.

b. Teacher Analysis

Based on interviews with biology teachers and observations of biology learning in the classroom, teachers have limitations in preparing interactive learning media so that the media used during biology learning are power point slides supported by laptops, projectors and smartphones. While the learning resources used are only in the form of textbooks from schools as student handbooks. The learning method that is often used is the lecture method but with a small portion and combined with the discussion method so that learning remains student-centered.

c. Student Analysis

The results of preliminary tests in class XII MIPA 8 showed that 77.8% of students had difficulty in understanding biology material using textbooks. The material contained in the textbook is more dominant with text making it difficult to understand a material. In addition, the use of media in learning biology is still less interactive. This is reinforced by the results of the preliminary test questionnaire, as many as 92.6% of students need electronic learning media that presents images and learning videos and is attractively packaged in supporting biology learning.

Excretory system material is quite difficult to understand. As many as 64.6% of students had difficulty in understanding the excretory system material. The percentage of students science literacy on excretory system material is 62.4% which is classified as low. According to Widayati et al. (2020), science literacy is the same as training individuals, especially students to have a responsive and critical mindset towards various forms of reading content that is known before being communicated to others, this means that everyone who is critical has good science literacy skills.

d. Facilities and Infrastructure Analysis

The facilities at Taruna Terpadu High School include markers, whiteboards, chairs and study tables. However, there is one facility that has not been supported, namely the projector which is still limited in number so that it is used alternately between subject teachers. Infrastructure at SMA Taruna Terpadu includes classrooms, teachers' rooms, library rooms, UKS rooms, sports fields, mosques and toilets. However, there is infrastructure that does not support laboratory space.

Biology subjects are very close to practicum activities, laboratory space that has not been supported is an obstacle in carrying out practicum activities so that biology teachers often conduct simple experiments and experiments in the classroom.

e. Environmental Analysis

In terms of the environment, Integrated Taruna Terpadu High School has a clean and well-maintained environment. Each classroom is facilitated with cleaning tools used by students in carrying out class pickets. In addition, the availability of quite a lot of trash cans makes students have good awareness in disposing of garbage in its place. Although located in a strategic location, the classroom is far from the noise of vehicles so that it does not interfere with students concentration during learning.

2. Design Stage

At this stage, the process of initial design and design in the preparation of learning media is carried out. The e-module was designed using the canva application and the visual studio code application to design the website. The initial stage is to design the concept and content contained in the e-module. After that, determine the layout and color selection that is suitable and attractive with the content of the excretory system material. The components contained in the e-module are divided into three parts, namely the opening, content and closing. The following e-module media design results are presented in table 1.

Table 1. E-module design

Design			
Cover	Identity	Preface	Table of contents
Directions for use	Feature explanation	Introduction	Diagram

Science context

Learning menu

Learning activities

Material description

Bio article feature

Bio discuss feature

Bio exercise feature

Bio fun fact feature

Bio lab feature

Bio resume feature

Bio task feature

Bio watch feature

Crossword

Answer key

Glossary

Bibliography

Compiler profile

Back cover

Web-based e-module display on the home page

Web-based e-module display on the view page

In addition, at design stage the preparation of science literacy instruments was carried out as many as 30 multiple choice questions. The preparation of the instrument was carried out by adjusting the coverage of excretory system material with science literacy indicators. Then the instrument was tested on students of class XII MIPA 8 at Taruna Terpadu High School. Of the 30 questions tested, there were 15 valid and reliable questions to be used as science literacy instruments in pretest and posttest activities.

3. **Development**

At this stage, the e-module that have been designed and designed are then validated by media experts and material experts to determine the feasibility of web-based e-module. A media can be said to be feasible if it has met the valid requirements through an assessment by measuring the aspects needed to analyze data from the variables studied (Nadira et al., 2022).

a. **Validation of Media**

Website-based e-module media validation is addressed to computer science lecturers. Based on the results of validation by media experts, it is known that the assessment of the graphic aspect scored 100% while the language aspect scored 100%. The final score of the two aspects is 100% with a very feasible category.

The validation assessment by media experts was only carried out once. There are notes of improvement, namely the addition of a bibliography related to the learning videos presented and sourced from YouTube and articles sourced from websites or scientific journals listed in the e-module need to be included. Regarding the results of the assessment by media experts, e-module that are packaged in an attractive and easy to understand manner can be used to stimulate students thoughts, feelings, attention and abilities or skills so as to encourage the learning process (Syamsiani, 2022).

b. **Validation of Material**

The material presented in the e-module is said to be feasible if there is conformity between the syllabus and the 2013 curriculum, basic competencies, indicators of competency achievement, and learning objectives are presented, complete and clear material, exercise questions and summaries (Salsabila et al., 2024). The material expert validation assessment covers three aspects, namely aspects of content feasibility, presentation feasibility and suitability for science literacy indicators. There are two material experts who provide assessments related to material validation, namely biological science lecturers and biology teachers are presented in figure 1.
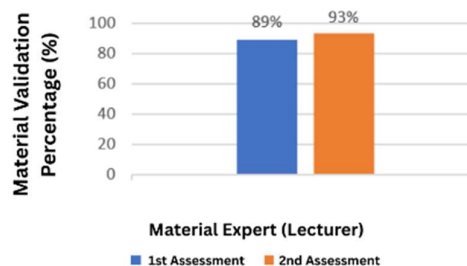
Figure 1. Graph of the increase in material expert validation (lecturer)

Based on the results of validation by material experts (lecturers), it is known that the first assessment scored 89% with very feasible criteria. There are several improvement notes including the addition of a science context that contains scientific problems or phenomena in the initial activities before learning. So that a second assessment was carried out so that the e-module developed met the science literacy indicators and obtained a better assessment. The second assessment scored 93% with very feasible criteria. The results of material validation by biology teachers are presented in figure 2.
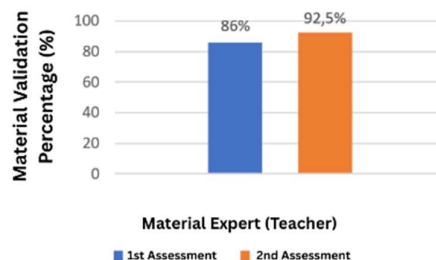

Figure 2. Graph of the increase in material expert validation (teacher)

Based on the results of validation by material experts (teachers), it is known that the first assessment scored 86% with very feasible criteria. There are several improvement notes including the addition of question exercises in the form of crossword puzzles at the end of learning activities. It is intended that students can identify, evaluate the questions presented in the developed e-module to match the science literacy indicators. After being improved according to suggestions and input, a second assessment was carried out which obtained a score of 92.5% with very feasible criteria.

c. **Validation of Science Literacy Instrument**

Validation of science literacy instrument is addressed to lecturers of biology learning evaluation. Based on the results of validation by science literacy instrument experts, it is known that the first assessment scored 69% with decent criteria. There are some improvement notes including the incompatibility between the items with the indicators of science literacy and there are items that present incorrect answer choices so that there is a

need for improvement. In the second assessment, the score was 91% with very decent criteria. The results of instrument validation are presented in figure 3.

Figure 3. Graph of improvement in expert validation of science literacy instruments

The science literacy instrument was then tested in class XII MIPA 8 which amounted to 25 students. The test of science literacy instrument aims to determine valid and reliable multiple choice questions in measuring students science literacy. Based on the results of the item validity test using the point biserial correlation formula, it is known that of all 30 science literacy questions, 22 questions were declared valid while 8 questions were declared invalid. This is supported by research by Qoridatullah et al., (2021), that if rpbi>r table then the test item is declared valid.

The results of the reliability test using the Kuder Richardson formula (KR20) obtained a coefficient value of $0.846 > 0.70$ so that it was declared reliable. The question instrument is said to be reliable if the reliability value is more than 0.70 (Sujana et al., 2020). From the results of the validity and reliability tests, 22 questions that were declared valid were selected 15 questions that represented science literacy indicators to be used in the pretest and posttest.

4. **Implementation Stage**

The e-module was implemented on a limited basis using a one group pretest-posttest research design or using one experimental class. The experimental class used was class XI MIPA 6 at Taruna Terpadu High School with 25 students. The implementation of e-module was carried out three times a meeting with the aim of knowing the effectiveness of using e-module as learning media in improving students science literacy in excretory system material.

The learning model used is discovery learning with question and answer, discussion and presentation learning methods. Discovery learning is a learning model that can make students actively involved directly in learning to build

and discover their own knowledge so that it is appropriate to use in science learning. According to Shinta et al. (2020), the discovery learning model basically makes students have the ability to ask questions, observe, collect information, process information and draw conclusions.

Learning activities at the first meeting began with a pretest then continued with accessing the e-module, working on discussion sheets in groups, presentations and questions and answers and working on practice questions. In the second meeting, students completed the discussion sheet in groups by accessing the e-module as a learning media source, then continued with presentation and question and answer activities, working on practice questions and individual assignments. In the third meeting, students again completed the discussion sheet in groups by accessing the e-module as a learning media source, then continued with presentation and question and answer activities. The next activity is the posttest and filling out the students response questionnaire and also the teacher's response to the use of website-based e-module learning media in improving students science literacy on excretory system material.

The effectiveness of e-module learning media is based on pretest and posttest scores which aim to determine the improvement of science literacy skills before and after conducting learning activities using website-based e-module on excretory system material. The following calculation of N-gain value in class XI MIPA 6 is presented in table 2.

Table 2. The results of the calculation of the N-gain value of class XI MIPA 6

Average Score		N-Gain	Criteria
Pretest	Posttest		
44	84,48	0,73	High

Based on the results of the effectiveness analysis using the N-gain calculation, it shows that the average pretest value is 44 and the posttest is 84.48 with an N-gain value of 0.73 with high criteria. This is in accordance with the interpretation of the N-gain value, if N-gain > 0.70 then it has high criteria (Wahab et al., 2021). The N-gain value shows an increase in students science literacy skills after learning activities using website-based e-module.

This is supported by the features in the e-module that are arranged in accordance with science literacy indicators. The bio fun fact feature which contains interesting facts and bio wacth which contains learning videos represent aspects of explaining scientific phenomena on indicators of applying science knowledge and applying science. While the bio discuss feature which contains group discussion sheets, bio exercise which contains practice questions and bio lab which contains practicum procedures represent aspects

of evaluating and designing scientific questions on indicators of identifying, distinguishing, exploring and evaluating questions given scientifically.

The bio article feature which contains scientific articles, bio resume which contains a summary of the material and bio task which contains assignments representing aspects of interpreting data and evidence scientifically on indicators of identifying assumptions, analyzing and interpreting data, drawing conclusions and distinguishing and evaluating arguments and scientific evidence from various sources. Thus, the use of e-module as learning media is very effective in improving students science literacy in excretory system material.

Furthermore, the prerequisite test was carried out, namely the normality test using the shapiro wilk formula. This is because the sample used is less than 50 so it uses the shapiro wilk formula to produce precise and accurate decisions (Setianingsih & Nelmiawati, 2020). The normality test aims to determine whether the data that has been obtained is normally or abnormally distributed. The following normality test calculation results are presented in table 3.

Table 3. Normality test results

Normalitas	*Shapiro Wilk* (Sig.)	Category
Pretest	0,70	Normally distributed
Posttest	0,65	Normally distributed

Based on the results of the normality test using the Shapiro Wilk formula, it is known that the normality value on the pretest is 0.70 and the posttest is 0.65. Both show a significance value (Sig.) > 0.05, so the data is normally distributed. Because the test results are normally distributed, then proceed with the T-test (paired sample T-test).

The paired sample t-test aims to determine the difference between the two data obtained, namely the pretest and posttest as paired data from the results of giving different treatments. According to Sugiyono (2019), the paired sample t-test is a test conducted to analyze the effectiveness of a treatment and shows the average difference after treatment. The following t-test calculation results are presented in table 4.

Table 4. T-test results

Paired Sample T-Test	Sig. (2-tailed)
	0,000

Based on the T-test results, it is known that the significance value (2-tailed) is 0.000 < 0.05. So there is an average difference between the pretest and posttest scores after using the e-module. It can be concluded that the use of website-based e-module on excretory system material has an effect on increasing students science literacy in learning biology on excretory system

material because there is a significant difference between pretest and posttest scores.

5. **Evaluation Stage**

At this stage, the practicality of using e-module is tested from the results of teacher response questionnaires and students responses. The teacher response questionnaire was addressed to the biology subject teacher of class XI MIPA at Taruna Terpadu High School with a total of 2 teachers. While the students response questionnaire is addressed to students of class XI MIPA 6 as an experimental class that uses e-module during learning with a total of 25 students. The following e-module practicality test from the results of teacher and students response questionnaires is presented in table 5.

Table 5. Practicality test of e-module

Practicality Test	Persentase (%)	Criteria
Teacher Response	99,5%	Very practical
Students Response	90%	Very practical

Based on the results of the teacher response questionnaire, a percentage value of 99.5% was obtained with very practical criteria. While the results of the students response questionnaire obtained a percentage value of 90% with very practical criteria. Biology subject teachers and students feel helped by the e-module as a biology learning media. This is because the developed e-module presents material in accordance with basic competencies and learning objectives using language that is easy to understand, especially for students.

In addition, the developed e-module presents features that can support students to improve science literacy and the e-module is very easy to access anywhere and anytime. This is supported by the opinion of Hutahaean et al. (2019), that the use of e-module in the learning process has several advantages, namely making it easier for students to access multimedia-based information in the form of audio, video, images, or animations so as to increase students motivation and interest in learning and provide a pleasant learning experience and can be accessed anywhere and anytime using a smartphone, tablet, laptop or computer.

CONCLUSION

Based on the results of the research conducted on the development of website-based e-module learning media, it can be concluded that the developed website-based e-module is said to be feasible, effective and practical in improving students science literacy on excretory system material. This is because the web-based e-modules developed have met the assessment criteria by media experts and material experts so that they are categorized as very feasible. The use of website-based e-modules is declared effective in improving students science literacy with the

acquisition of an N-gain value of 0.73 which is categorized as high. In addition, the web-based e-module developed presents features that can support students to improve science literacy with the acquisition of practicality scores from the results of teacher and student response questionnaires categorized as very practical. In connection with the research that has been carried out in a limited manner using a sample of one class, so it is necessary to conduct further research using a wider sample.

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