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Visualizing the Human Reproductive System Material Through Web-based E-module

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ABSTRAK

Pada abad 21 disebut dengan abad digital, sehingga pembelajaran diharapkan dapat memanfaatkan teknologi. Guru belum memanfaatkan teknologi dengan semaksimal mungkin, sehingga pembelajaran di kelas menjadi belum optimal. Penelitian ini bertujuan untuk mengembangkan bahan ajar e-module berbasis web pada materi sistem reproduksi manusia untuk siswa SMA/MA kelas XI. Model penelitian dan pengembangan menggunakan ADDIE. Subjek penelitian terdiri dari 1 ahli media, 1 ahli materi, 2 guru biologi, dan 30 siswa. Metode pengumpulan data terdiri dari observasi, wawancara, dan kuesioner. Analisis data menggunakan deskriptif kualitatif dan deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa Skor penilaian dari ahli media sebesar 3,82 (sangat valid); Skor dari ahli materi sebesar 3,50 (valid); Skor dari guru biologi sebesar 3,91 (sangat valid) dan skor siswa sebesar 3,46 (valid). Maka dari itu dapat disimpulkan bahwa e-module berbasis web pada materi sistem reproduksi manusia layak digunakan dalam pembelajaran biologi. E-module berbasis web dapat membantu siswa kelas XI untuk belajar mandiri kapan dan dimana saja serta membantu dalam memahami materi sistem reproduksi manusia.

ABSTRACT

The 21st century is the digital age, so learning is expected to take advantage of technology. Teachers have not utilized technology as much as possible so learning in the classroom is not optimal. This study aims to develop a web-based e-module teaching material on the human reproductive system for high school/MA class XI students. The research and development model uses ADDIE. The research subjects consisted of 1 media expert, one material expert, two biology teachers, and 30 students. Data collection methods consist of observation, interviews, and questionnaires. Data analysis used descriptive qualitative and quantitative descriptive. The results showed that the assessment score of media experts was 3.82 (Very Valid); the score of material experts was 3.50 (Valid); the score of the biology teacher was 3.91 (Very Valid), and a student score of 3.46 (Valid). Therefore, it can conclude that the web-based e-module on the human reproductive system material is suitable for biology learning. Web-based e-modules can help class XI students to study independently anytime and anywhere and to understand material on the human reproductive system.

1. INTRODUCTION

The challenges of life to compete in all aspects of the 21st century are getting bigger (Arnata et al., 2020; Rawung et al., 2021). Education is a way to prepare a generation that is competent and able to adapt to current developments. Technology is one of the means that can advance the world of education (Agustian & Salsabila, 2021; Kurniawati et al., 2019; Pramana et al., 2020; Rusnawati, 2020). The application of technology in education is one of the essential points in the development of the Industrial Revolution 4.0 (Ramadhani & Fitri, 2020; Rosalina et al., 2021). The industrial revolution 4.0 changed much more universally in the 21st century. The development of the 21st-century world marked by the utilizing of Information Technology and Communication (ICT) in all aspect of life has affected every aspect of life included in the learning process (Kurniawati et al., 2019; Rawung et al., 2021). The integration of ICT in education is also growing rapidly (Shanmugam & Balakrishnan, 2019). Educators must also be skilled in media and technology (Adlin, 2019; Rokhim et al., 2020; Sumantri, 2019). Teachers can also use learning resources from sites on the internet which can be accessed by students and teachers. There are many reasons why biology concepts are considered problematic by students. Several factors make it difficult for students to learn biology, including too many biology curricula, the abstract and interdisciplinary nature of biology concepts, and difficulties with textbooks (Çimer, 2012; Nisak et al., 2019; Setiyani, 2020). Therefore, there is a need teaching material that can help students understand. One of the seemingly difficult materials is human reproductive system. This material is considered difficult because it contains any concepts that students should understand. The quality of education can be seen from teachers' teaching materials and teaching styles. In general, high school level remains to use such conventional textbooks. All teachers claim that there is an

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alternative teaching material that can improve students' skills (Bustami et al., 2018; Nastiti et al., 2018). One material that requires an alternative teaching material is human reproductive system.

The selection of teaching materials for the human reproductive system is very supportive because the material discusses many problems related to sexual deviation and reproductive health. Students today live in an environment full of visual images, and without exception, the learning materials they are learning. the student in an age of technology-oriented and science dependent in drawings to present information (Rum et al., 2021; Wusqo et al., 2021). So by developing this web-based e-module, students can build enthusiasm to learn the material on the human reproductive system that is packaged in an attractive and futuristic way. E-module also have many virtues as a teaching material that is systematic, can be used independently, and accessible at any time and anywhere.

Modules are teaching and learning units that cover specific topics systematically (Asrowiah et al., 2021; Khotimah et al., 2021; Sidiq et al., 2021; Sunaryo et al., 2020). The module being developed is not a print module but an electronic module (e-module). The developed e-module is web-based. Website media is considered an alternative to an independent learning medium for students. This e-module was developed with the help of an official feature from Google, namely Google Sites. The developed e-module can be used by students anywhere and anytime as long as an internet network can be accessed (Adzkiya & Suryaman, 2021; Setyawan, 2019). The reason for choosing the website is that the website is a service that users can access for free by electronic devices such as smartphones, computers, and tablets connected to the internet network (Afifah et al., 2021; Bhagaskara et al., 2021). Websites can be in the form of text, images, audio, or video that can be accessed via links (Jubaidah & Zulkarnain, 2020; Khasanah & Muflihah, 2021; Mardin & Nane, 2020; Setyawan, 2019; Yuniarto et al., 2021). Websites have the advantage of linking (linking) one document to another (hypertext) that can be accessed through a browser. This can make it easier for students to explore other learning resources. Google Sites is an intelligent solution in learning because users are given the freedom to be creative in creating learning media. You can add learning support on Google Sites, such as syllabi, videos, animations, Student Worksheets (LKPD), attendance lists, and pictures. Google Sites also supports input for other Google applications such as Google Sheets, Google Docs, Calendar, Google Forms, Google Drive, Google Analytics, etc (Adilla et al., 2019; Mukti et al., 2020). Based on observations and interviews, teachers cannot yet make electronic teaching materials. Teachers use only printed teaching materials such as print modules and printed worksheets. Based on the needs analysis questionnaire results, 83.3% of students found it challenging to understand the concepts of biology learning. 47.2% feel bored when studying biology. 88.9% of students are interested in learning web-based e-module biology. 100% of students agree to develop a web-based e-module. The basis for developing 21st-century education is to lead to students-centered education (Herawati, N. S., & Muhtadi, 2018; Saputra, 2021). Students must be active in constructing their knowledge and finding solutions to problems. Students are expected to be active learners seeking information, creatively generating ideas for problem-solving and critical thinking, and communicating these ideas effectively to others.

As a result of the enormous demands and influences of the Industrial Revolution 4.0 and the 2013 Curriculum, teachers need to develop technology-based teaching materials that are easy to use by both teachers and students and can be easily accessed via mobile devices (Ramadhani & Fitri, 2020; Yolanda & Rizal, 2021). Therefore, researchers want to develop teaching materials on current developments, namely the Electronic Module (e-module). Based on the previous statement, the researcher offers an alternative web-based e-module solution that students can use flexibly. The school's internet network infrastructure supports this innovation, so students can easily access the developed website-based e-module. This statement is supported by the results of previous research that e-modules can be used as an alternative to fun learning and increase students' knowledge (Sari et al., 2019; Tri et al., 2021). Web-based e-module is suitable for learning (Solihudin JH, 2018; Yayang & Eldarni, 2019). E-modules can be used as additional learning resources (Herawati, N. S., & Muhtadi, 2018; Putra et al., 2019; Yayang & Eldarni, 2019), improve the achievement of knowledge competence (Darwin et al., 2020; Solihudin JH, 2018), and improve students' critical thinking skills (Selviani, 2019; Sholikhah et al., 2022; Sulistiani, S., Kartimi, K., & Sahrir, 2022).

The research aims to develop web-based e-module teaching materials on the human reproductive system. The product resulting from developing a web-based e-module is expected to build motivation and improve learning outcomes in biology, especially in the human reproductive system. The web-based electronic module developed in this study offers a new approach in teaching the human reproductive system, especially through a digital platform that can be accessed by students independently and interactively. The novelty lies in the integration of modern technology in biology learning, which previously relied more on traditional learning methods or printed modules.

2. METHOD

This type of research is Research & Development (R&D) using the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). ADDIE concept can be seen in Figure 1. The research locations for the limited trial are SMA Negeri 1 Parittiga and SMA Plus Muhammadiyah Toboali. The research subjects consisted of 1 material expert, one media expert, and two biology teachers. The test subjects consisted of 30 students, with 15 students in each school.

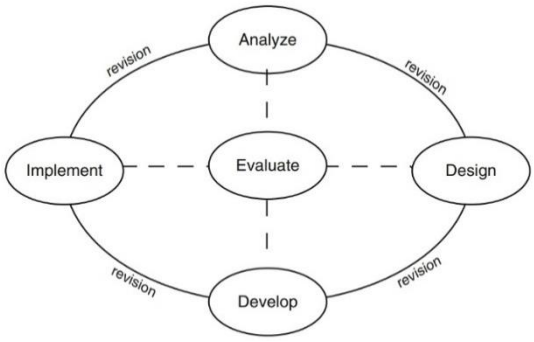

Figure 1. The ADDIE concept

Methods of data collection with interviews, observations, and questionnaires. Interview and observation methods are used to find problems and obstacles in learning faced by teachers and students. In contrast, the questionnaire method is used to provide an assessment questionnaire that contains statements to respondents regarding the web-based e-module material for the human reproductive system. A questionnaire was given to students with 12 statements consisting of 5 e-module assessment indicators, such as interesting material, language, easier operation, visualization, flexibility. Validation assessment limits are good or not the e-modules based on the score interpretation criteria for the Likert Scale. The Likert Scale is used to measure the general attitude, opinion, and perception of a person or a group of people with social phenomena (Sugiyono, 2018). Scores obtained from material expert, media expert, biology teacher, and student's are conversed from quantitative data to qualitative data.

The ADDIE development model procedure used to develop e-module products consists of 5 stages, such as analysis, design, development, implementation, and evaluation. However, this research will only explain the first to third stages. The initial stage begins with the analysis stage consisting of curriculum analysis, student characteristics, and analysis of school facilities. At the curriculum analysis stage, it was carried out to determine the competencies used in schools which refer to the 2013 Curriculum. Based on the analysis of student characteristics through teacher interviews, students preferred video-based or digital learning media. Meanwhile, from the analysis of facilities at the school, there are still few teaching materials, but the school already provides Wi-Fi. The results of this analysis will be taken into consideration for designing e-modules at the next stage.

At the e-module design stage, the activities carried out at this stage are creating storyboards, determining the website to be used, collecting images and videos, collecting references that will be used to support the material, creating concept maps, and creating assessment instruments for product validation. The web-based e-module will be created with Google Sites, Google's official website creation facility. Google Sites can be accessed for free and is created according to a format that supports it. Web-based e-module development design arranged in the form of storyboards and flowcharts. The design of the main web menu consists of the homepage, activities learning, evaluation, glossary, bibliography, our forum, and profile writer. The e-module will be evaluated based on its suitability as a learning product with an instrument in the form of a questionnaire. This evaluation tool will be validated first and given to validators who come from expert lecturers and biology teachers, as well as students.

At the e-module development stage, gradually combine material content with images, videos and animations into Google Sites until it becomes a complete web-based e-module. After the product is created, validation is carried out by material experts, media experts, practitioners, and limited testing on students. This activity aims to obtain suggestions and input so that the product can be improved to be better. If it has been revised according to suggestions and input, it can proceed to the next stage, namely implementation on a broader subject (Sukardi, 2009). Futher qualitative analysis of the scores and interpretation by the validity criteria at the following Table 1.

Table 1. The validity Criteria

Average	Validity Criteria
4.00 – 3.75	Very valid
3.75 – 3.00	Valid

Average	Validity Criteria
3.00 – 2.25	Fair
2.25 – 1.50	Less valid

3. RESULT AND DISCUSSION

Result

This development research aims to produce products in the form of biology e-module teaching materials with material on the reproductive system, which is equipped with instructions for using media, learning activities, LKPD, evaluations, bibliography and discussion forums. Apart from that, there are also unique facts to broaden students' insight regarding the human reproductive system. This e-module was developed to facilitate teachers in teaching class IX students so they can learn independently, increase their learning motivation, and help understand the material.

Analysis Stage

The observation was carried to school to find out the background of the problems associated with needs of teachers and students. From observation and interviews, it was discovered that teacher still use textbook and teacher-oriented learning activities. This makes students tend to get saturated easily. The availability of available teaching material and media is limited, especially for human reproductive system topic. Furthermore, teacher innovation was minimal. This has resulted in a decline in students' learning motivation. The curriculum used in schools referred to the 2013 Curriculum. Based on curriculum, there are human reproductive system materials that will be develop in the e-module of biology. The development of web-based e-module as teaching material for biology subject in human reproductive system topic was preceded by designing the e-module. In general, it contains the human reproductive system topic including reproductive organs and functions of the male and female reproductive system, gametogenesis, menstrual cycle, and reproductive disease. At the analysis stage, the results of the questionnaire analysis showed that 47.2% of students felt bored when studying biology. Although almost half of the students said that biology was boring, 97.2% found biology fun. The results of the observations show that students feel bored with learning biology because the printed books used in learning only contain material briefly and in black and white. Less attractive teaching materials will make students not motivated to learn. School facilities already provide Wi-Fi, but it has not been used optimally.

Another problem found in the field and teachers' interviews is that schools often hold activities outside of teaching and learning activities during learning hours. For example, there are teacher meetings and visits from outside the school, such as blood-adding activities, to stop learning activities. Even students were sent home suddenly by the school. This causes the material is not delivered effectively, so students learn independently at home. However, students only have printed books purchased from the school, so students need other learning resources to study from home. Students prefer teaching materials that can be accessed via gadgets. So that e-module is the right solution that can be used anytime and anywhere.

Design Stage

The second step is design. At the design step a design are: 1) flowchart and a storyboard of web-based e-modules. 2) create a web-based e-module framework, this arrangement is done to illustrate the outline of the web-based e-module as well as systemic of the material on the e-module. 3) sets the web-based e-module design. Web-based e-modules are designed to use Google Sites. This design stipulates that the web-based e-modules look attractive and easy to read. 4) craft an assessment instrument. Instruments are developed to know the validity of the product being developed.

Development Stage

The third step is development. At the step of this activity development undertaken that is: 1) the content development web-based e-modules. 2) e-module development. Once materials are developed into whole teaching materials, the they continue with the development of modules that can be accessed via laptop or smartphone. The modules that have been developed will be tested for feasibility of web-based e-module products by media experts, material experts, biology teachers and students. Media and material experts come from expert lecturers at the Postgraduate Biology Education Yogyakarta State University. Especially for assessment of the material aspect consists of three criteria, including aspects of the feasibility and accuracy of the material, material presentation techniques, relevance of facts, and material concepts. The result of the assessment of validity by the material expert can see on Table 2.

Table 2. Results of The Assessment of Validity by The Material Expert

Assessment Item Number	Assessment Aspect	Score	Category
1-5	Material accuracy	3.60	Valid
6-12	The material presentation technique	3.56	Valid
13-15	Relevance of fact and concept	3.44	Valid
Average		**3.50**	**Valid**

Based on Table 2, it can be seen that all aspects are classified as Valid, with an average score of 3.50. This shows that the web-based e-module is by the core competencies, basic competencies, and learning objectives. Core Competencies on the 2013 curriculum represents the level of ability to achieve the level of graduate competence a learner must have at each class level. While, the assessment of the media aspect consists of six criteria, including display quality, language, ease of operation, website reliability, literacy quality (text, images, video), and ease of use. The result of this test can see on the Table 3.

Table 3. Results of The Assessment of Validity by The Media Expert

Assessment Item Number	Assessment Aspect	Score	Category
1-4	View quality	3.75	Very Valid
5	Language	4.00	Very Valid
6-7	Easier operation	3.50	Valid
8-9	Web reliability	4.00	Very Valid
10-12	Illustration quality (text, picture, and video)	3.62	Valid
13	More substance use	4.00	Very Valid
Average		**3.82**	**Very Valid**

Table 3 shows that the results of the web-based e-module feasibility assessment on aspects of display quality, language, ease of operation, website reliability, and illustration quality are 3.82 (Very Valid). This shows that the web-based e-module is declared suitable for use in the biology learning process on the material of the human reproductive system. The menu available on the e-module consists of a home menu, learning activities, evaluations, glossary, bibliography, our forms, and authors' profiles. Display views on smartphones and laptops are a little different. Font and layout adjustment follow the smartphone, since students prefer learning from the smartphone. The display of a web-based e-module using a computer/laptop and smartphone in Figure 2.

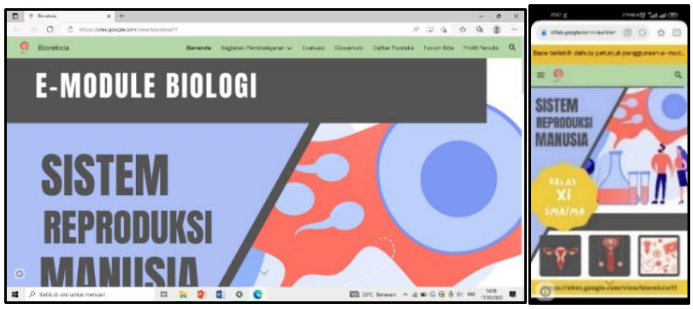

Figure 2. E-module Views Using Computers/Laptops (Left) and Smartphones (Right)

Base on Figure 2, home menu consists of the module's cover identity, basic competence, use instruction, and material recognition. The learning activities menu contains materials, videos, pictures, and interesting facts. The evaluations menu contains worksheet of learner. The glossary menu contains explanations of terms. The bibliography contains a list of all the books or scientific writings that are referred to. The our forms menu contains developer contacts and news. Thus, author's profile contains developer history. A result of the assessment of validity teacher is show in Table 4.

Table 4. Results of the Assessment of Validity by the Biology Teacher

Assessment Item Number	Assessment Aspect	Score	Category
1-4	Material/Content	4.00	Very Valid
5-6	Language	4.00	Very Valid
7-11	Media	4.00	Very Valid
12-17	Learning	3.92	Very Valid
Average		**3.91**	**Very Valid**

The biology teachers and students used for this stage are from SMA Plus Muhammadiyah Toboali and SMA Negeri 1 Parittiga. Based on Table 4, it can be seen that the results of the web-based e-module feasibility assessment by biology teachers in the aspects of assessing material, language, media, and learning are classified as Very Valid. Response by the students is show in Table 5.

Table 5. Results of The Assessment of Response by The Students

Assessment Item Number	Assessment Aspect	Score	Category
1-4	Interesting material	3.54	Valid
5	Language	3.68	Valid
6-7	Easier operation	3.27	Valid
8-11	Visualization	3.43	Valid
12	Flexibility	3.40	Valid
Average		**3.46**	**Valid**

The validity test of the product was conducted with limited testing of 30 12th graders from 2 different school. There are five indicators used to test the validity of web-based e-modules: material, language, easy use, visualization, and flexibility. Based on Table 5, it can be seen that the students gave an excellent response to the web-based e-module. This is based on the responses given by students, namely the delivery of material that is easy to understand, reasonable, and very useful. However, some suggestions and inputs are given by students. Namely, some images must be changed into more compelling images, especially for visualization of human reproductive system with more interesting images. This suggestion has been corrected by replacing less attractive images with more appealing ones. The product has been revised based on the suggestions and inputs given.

Discussion

Basic competence is the minimum learning ability and materials that learners must accomplish for a subject to each education unit that refers to core competence. Learning objectives is a description of achieving the three aspects of competence, which is knowledge, skill, and attitude. An teachers must be able to determine the right and effective learning media, because it greatly affects the success of learners in achieving learning objectives (Priananda & Hadromi, 2021; Zulkarnain et al., 2021). It is appropriate in terms of presentation and illustrations used in the material aspect. In addition, the presentation of the material is relevant to everyday life. The language used does not cause ambiguity and uses communicative language so that students easily understand it. The average score of the three aspects obtained from the material experts' assessment shows that the material presented on the web-based e-module is declared suitable for use with some suggestions and input. The evaluation should be improved by suggestions and input from material experts, namely correcting typos and Indonesian grammar, and concepts that are still inaccurate or even wrong must be corrected and completed. Suggestions and inputs have been improved and completed.

Other supporting media such as videos are obtained from YouTube, image media are obtained from Google, and the source material is obtained from reference books and articles. The supporting applications for designing web-based e-modules use Canva, Liveworksheets, Flipbook, and Quizziz. At the Development stage, namely the refinement of the storyboard and the feasibility test. Web-based e-module on material in the human reproductive system is accessible through links https://sites.google.com/view/bioreksia11. This shows that the web-based e-module is feasible to be used in the biological learning process on the material of the human reproductive system. One alternative learning media that educators can choose is website-based. Google Sites can optimize the online learning process in their respective places according to the circumstances and environment of the school. Biology teacher gave advice on how to fix the cover design the web-based e-module became more interesting.

Based on the linguistic component aspects, the e-module meets the valid criteria. This shows that the sentences used in the e-module are clear in good and correct Indonesian so as not to cause confusion and make it easier for students to learn (Hastari et al., 2019; Pramana et al., 2020; Prasetya et al., 2017; Seruni et al., 2020). Judging from the visualization aspect, the e-module obtains valid criteria. The e-module design developed is attractive to students. The design includes the size, color and type used, attractive layout and design, image illustrations that match the material. One of the impacts of increasing students' attention, motivation and interest in learning is the impact of providing varied colors on the e-module display (Dwi Lestari & Putu Parmiti, 2020; Isma et al., 2023). From this limited test results show that students can access the e-module easily because they only need to click on the given link. So that students do not need to download an application to use the e-module. The e-module can be used independently by students in class and outside the classroom because this e-module can be accessed via a smartphone (Nisa et al., 2020; Saputra, 2021; Sulthon et al., 2020; Tri et al., 2021; Trilestari, K., & Almunawaroh, 2020).

E-module developed web-based e-module has been revised according to suggestions and input from experts, practitioners, and students. Web-based e-modules are suitable and suitable for learning. This is seen in terms of the material presented, the language used, the ease of operating the website, the addition of illustrations to support understanding and the presentation of e-modules as an attractive medium for students. This opinion is supported by previous research that e-module is feasible (Kimianti & Prasetyo, 2019; Pramana et al., 2020; Rahmatunisa et al., 2022; Sunaryo et al., 2020), valid, and practical (Amalia et al., 2020; Ameriza & Jalinus, 2021; Puspita et al., 2022) can be used as effective teaching materials (Artiniasih et al., 2019; Darwin et al., 2020; Fathima'ruf et al., 2021; Hastari et al., 2019).

The material in the e-module was developed in accordance with Curriculum 13 which applies both to the demands of core competencies (KI) and basic competencies. The correctness of the substance of the material being developed has an impact on the absence of conceptual errors for students (Imaningtyas et al., 2016). In addition, e-modules can help students improve higher-order thinking skills (Sunaryo et al., 2020), and critical thinking (Pratiwi et al., 2021; Sulistiani, S., Kartimi, K., & Sahrir, 2022). So the development of this web-based e-module can improve learning quality to achieve the targeted competencies. The use of technology in learning has had a positive impact on teachers and students, namely it can improve student achievement in 21st century skills (Perdana et al., 2019). Therefore, this e-module with reproductive system material that has been developed can be an alternative learning support media that will help students learn.

Implications of this study Web-based e-module provide wider accessibility for students and teachers. Materials can be accessed anytime and anywhere, thus supporting distance learning or blended learning. This can increase student participation in learning, especially for those who have limited time or access to physical resources. By using web-based e-modules, students can learn independently and set their own learning pace. This encourages the development of independent learning skills as well as students' ability to understand more complex concepts such as the human reproductive system. However, not all schools or students have access to stable internet or adequate technological devices. This can limit the effectiveness of web-based e-modules, especially in remote areas or with limited educational infrastructure. Not all students and teachers have good digital literacy to access and utilize web-based e-modules optimally. Additional training is needed so that the use of technology in learning can run effectively.

4. CONCLUSION

These results indicate that the web-based e-module are valid and worthy of use for biology study, this is based on the review and validation of the materials experts, media experts, biology teacher, and the trials of 12th class learners. The developed web-based e-module is practically packaged and interesting as a raw material in human reproductive system material. The teaching material that appeals to students will build learning motivation, thus affecting the results. It is suggested that educators use the web-based e-module's teaching materials it increase the motivation and learning results of students.

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