Validation of Circulation Systems e-Modules based Learning Cycle 8E

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ABSTRACT

This study is aimed for developing an electronic module (e-module) on the material of circulation system based on learning cycle 8e. This type of research and development used the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model. The used research instruments were interview sheets and validation questionnaires. The e-module was validated by three experts and the validated aspects were included aspects of didactic, construction and technical. The obtained data were analyzed quantitatively and described descriptively. The results of the study found that the didactic aspect obtained the highest validity value of 96.15% in the II learning material. While the construction aspect found the highest validity value in learning material III was 95.63%. In the technical aspect, the highest score was obtained in learning material III of 93.75%. Therefore, it can be concluded that the e-module circulation system based on learning cycle 8e has good quality and can be used in learning activities.

Keywords: E-Module, Circulation System, Learning Cycle 8E

INTRODUCTION

In March 2020 the Covid-19 pandemic spread in Indonesia, this had a serious impact on community activities in field of educational, economic and social. In 2022, the Indonesian government should decide to implement blended learning by combining limited face-to-face and online learning (Deklara et al., 2018). This new policy has caused various problems, such as limited meeting time between students and teachers, students have difficulty adapting, teachers must use technology and information for the learning process and learning goals must be achieved (Ucup, 2021; Futra et al., 2021). The application of blended learning was required readiness to learn from various parties such as schools, officials and students. This learning could be done by using various interactive learning platforms with the help of the internet and learning system management. Internet-based interactive learning platforms that

are always used such as Google meet, zoom meeting, WhatsApp (Futra, et al 2021) and also use electronic modules (e-modules) (Widiastutik, 2021).

Meanwhile, based on the results of the 2018 report (PISA) organized by the OECD as a study to evaluate students' 21st century competencies in science and mathematics. Where the studies carried out by PISA in the fields of science and mathematics involve various countries in the world. The achievements of Indonesian students are ranked 71st out of 79 participating countries (PISA, 2018). The low achievement of Indonesian students in science and mathematics will contribute to the competitiveness of education in the future. In addition, Indonesia's low educational achievement will also contribute to the low literacy skills and problem-solving abilities of Indonesian students in learning. In addition, an effort was made to improve the achievements of Indonesian students, by producing a learning media. This aims to facilitate students in mastering science material. Teaching materials that are always used in learning biology subjects with specific purposes such as modules in printed form (Agustin and Alberida, 2022: Restiana *et al*. 2022) and modules in electronic form (Nia *et al*., 2022; Mely *et al.,* 2021: Emanuel and Khoirun Nisa, 2020). E-module teaching materials are more popular in learning because they have advantages such as; easy to carry with digital devices, can be searched in electronic systems and can be inserted animation, audio and video media.

Based on a needs analysis conducted through observation and interviews at SMA Negeri 1 Sentajo Raya, Sentajo Raya District, Kuantan Singingi Regency, Riau. Based on the results of observations, information was obtained that digital-based teaching materials used by teachers in schools were generally in the form of power points, videos from YouTube. Meanwhile, multimedia applications for learning are used such as whats apps, google classroom, zoom meeting, and google meet. In addition, the results of interviews with several students at the same school obtained information that (1) the circulation system material was difficult for students to understand because it was abstract, that is, it could not be seen by naked eye and the presentation of the material was very complex, (2) the average student score on circulation system material 60% under the minimum completeness criteria (KKM), (3) teachers use conventional methods in learning activities. Besides that, based on a report from the Education Assessment Center of the Ministry of Education and Culture TP 2018/2019 on National student UNBK scores, it was found that 46.65% of students were able to answer correctly on the circulation system material (Kemendikbud, 2019). Therefore, the use of digital-based teaching materials must be further enhanced with the aim of increasing students' biological mastery and literacy. In addition, students are also able to study independently and can understand learning material, especially the circulation system effectively and efficiently.

The development of e-modules can be integrated with learning models so that they can direct student activities in learning independently. Several learning models have been integrated with e-modules such as the problem-based learning model (Nia *et al*., 2022), the

guided inquiry model (Santi *et al*., 2016), the multiple intelligence model (Emanuel and KhoirunNisa, 2020), and the learning cycle (Mely *et al*., 2021; Sitti *et al*., 2015). The learning cycle learning model is more extensive because it has many advantages such as; students can receive experience and be understood from others, increase learning motivation because students are actively involved, students are able to develop their potential and learning is more meaningful. Meanwhile, the learning cycle learning model that has been studied using a learning cycle consisting of e5 is about the development of learning media and the application of learning cycle 5e (Fransiskus & Ismi, 2020; Yuyun *et al.,* 2019), learning cycle 7e is about developing materials teaching and application of learning cycle 7e-based learning (Laila *et al*., 2018; Anwari *et al.,* 2017). Then, learning cycle 8e deals with cognitive analysis of students at school (Dewi *et al*., 2019; Elsa *et al.,* 2019). The learning cycle 8e model is the newest learning model, so far no one has published about the development of teaching materials and learning media using this model. The advantages of the learning cycle 8e model are constructivism-based learning, namely linking new knowledge that students have acquired with their initial knowledge so that learning is based on real experiences (Annisa, 2019). Learning Model learning cycle 8e is a gradual learning cycle consisting of several series designed so that students can play an active role in learning and master the competencies required in learning activities (Desi *et al.,* 2018).

Several recent studies have published about the learning cycle learning model. Mely *et al*., (2021) have developed an electronic module based on the 5e learning cycle and applied it to the buffer solution material. Sitti *et al.,* (2015) have also developed an e-module based on learning cycle 7e on fluid dynamics material. Anwari et al., (2017) have proposed the development of a learning cycle 7e-based module on molecular biology material. Ali et al., (2021) have also discussed the development of the 5e learning cycle module on natural science (IPA) material. Nurul *et al*., (2019) has also developed a 5e learning cycle module in mathematics learning. In general, the learning cycle learning model has been developed with stages consisting of 5e and 7e, while stage 5e is engagement, exploration, explanation, elaboration, evaluation while stage 7e is elicit, engagement, exploration, explanation, elaboration evaluation, extend (Anwari *et al*., 2017; Hargiono *et al*., 2016). The learning cycle learning model that has been applied in the field of biology, especially in molecular materials, while in circulation system material has never been reported.

Therefore, this study aims to conduct research on the development of circulation system e-modules based on learning cycle 8e. Where the learning cycle learning model discussed involves stages such as engage (involve or interest students in learning), explore (investigate learning problems), esearch (search for problem solving), elaborate (apply or relate to everyday problems), exchange (exchanging or discuss), extend (expand or associate with other material), evaluate (assess), explain (explain or conclude) (Ridwan & Rahmawati, 2018). Thus, the e-module based on learning cycle 8e is expected to be able to help students learn independently, especially on circulation system material.

METHOD

The research location is in the Biology Education Postgraduate Program, University of Riau. The type of research on the development of circulation system e-modules based on learning cycle 8e is research and development (R&D). The subjects of this study consisted of three experts, namely one material expert, one pedagogic expert, and one media expert. The development model used is the ADDIE development model. The ADDIE development model consists of five stages, namely the analysis, design, development, implementation and evaluation stages (Rusdi, 2018). The e-module validation stage only reaches the development stage. The stages of the ADDIE development model are simply summarized (Ma'as *et al*., 2013) as follows:

1. The analysis phase includes curriculum analysis, analysis of teaching materials, material analysis and analysis of students' needs.
2. The design stage includes the design of learning devices and the design of e-modules.
3. The development stage includes the e-module validation stage for 3 experts. The assessment aspects for the validity test questionnaire include didactic, construction, and technical aspects.

Data collection in this study was carried out by means of observation, interviews, and questionnaires. Observations were made during pre-research to determine the test scores of class XI students at SMA Negeri 1 Sentajo Raya. Interviews were conducted openly to find out the teaching materials used by teachers in schools. Questionnaires are a way of collecting data by providing a list of questions to experts who assess the feasibility of the e-module (Agung, 2017).

The assessment instrument used was a questionnaire consisting of 3 parts. Part 1 discusses the didactic aspect, part 2 discusses the construction aspect and part 3 discusses the technical aspect. Data collection techniques are in the form of questionnaires and observations. The questionnaire scoring sheet uses a Likert scale, while observations are made for preliminary studies. The criteria for the validity test questionnaire are summarized in Table 1:

Table 1. Criteria score assessment questionnaire validity

No.	Score assesment	Category
1	4	Verry good
2	3	Good
3	2	Not enough
4	1	Not good

The Likert scale validity questionnaire data is processed using the proportion formula, the formula for calculating the validity proportion of e-module circulation system based on learning cycle 8e uses equation 1:

$$\text{Percentage (\%)} = \frac{\text{Score obtained}}{\text{Score maximum}} \times 100\%$$

Where, the highest score is the maximum score x the number of instrument items. Criteria for the feasibility level of e-module product analysis on 3 aspects are presented in Table 2.

Table 2. Percentage analysis criteria in 3 aspects of e-module (Riduwan, 2012:19)

No.	Percentage (%)	Category
1	80,00-100	Valid
2	60,00-79,99	Sufficiently valid
3	50,00-59,99	Less valid
4	0-49,99	Feasible invalid

RESULT AND DISCUSSION

The learning cycle 8e-based circulation system e-module was developed and arranged based on basic biology competencies in accordance with the 2013 curriculum. This circulation system module is structured consisting of a cover, an opening section, a learning activity section and a closing. This composition is in accordance with the theory that a good e-module consists of a cover, introduction, learning activities and cover (Fadieny and Fauzi, 2021). The discussion in this article is focused on the analysis, design and development stages.

Analysis

Analisysis Curiculum

The results of interviews with biology teachers at SMAN 1 Sentajo Raya, MAN 1 Kuantan Singingi and SMAN 12 Pekanbaru found that teachers use the 2013 revision of the 2018 curriculum, therefore, the e-module being developed refers to the 2013 curriculum 2018 revision. Where the circulation system material is with KD 3.6 concerning "analyzing the relationship between the structure of the organ-composing tissue in the circulatory system in relation to bioprocesses and functional disturbances that can occur in the human circulatory system". KD 4.6 about "presenting papers about abnormalities in the structure and function of the blood, heart, blood vessels that cause disturbances in the human circulatory system and their relation to technology through literature studies".

Analysis of Teaching Materials

Based on open interviews conducted at SMAN 1 Sentajo Raya, MAN 1 Kuantan Singingi and SMAN 12 Pekanbaru. The results obtained several findings, namely (1) the teaching materials used were only printed books from publishers such as Erlangga, Yudistira and the Ministry of Education and Culture, (2) electronic learning media used by teachers in the form of videos from YouTube, and power point (ppt). Therefore, learning about circulation system material is highly encouraged for the development of teaching materials in the form of e-modules on circulation system material based on learning cycle 8e.

Material Analysis

Observations on learning materials were carried out at SMAN 1 Sentajo Raya, MAN 1 Kuantan Singingi and SMAN 12 Pekanbaru on biology subjects. Observations were carried out to obtain daily repetition values on the sub-topics of cells, plant tissues, animal tissues, locomotor systems, circulatory systems, and digestive systems. The daily test scores for biology class XI are summarized in Figure 1.
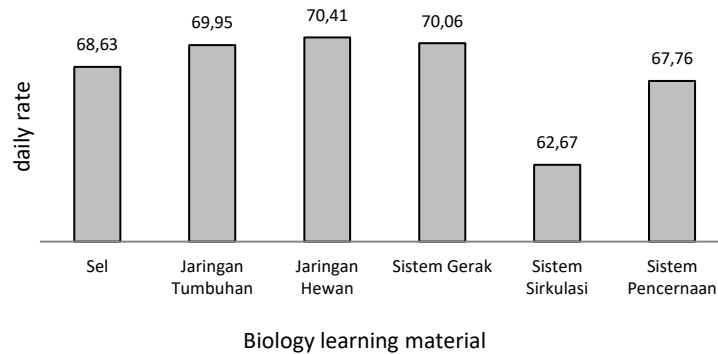

Figure 1. Average daily test scores for students in class XI biology material

Based on Figure 1, it was obtained that the average daily test scores of students in biology subjects were highest found in animal tissue material and locomotion systems. Where the value of this subtopic is obtained daily test scores of 70.41 and 70.06 respectively. The lowest daily test value is found in the circulation system material of 62.67. In general, the daily test scores for learning subjects on the subtopics of cells, plant tissues, animal tissues, locomotor systems, circulatory systems, and digestive systems are obtained by the KKM score. Meanwhile, the circulation system material obtained the lowest daily test scores and was very far from the KKM score. Therefore, the development of e-modules on the circulation system sub-topic based on learning cycle 8e is very appropriate to be developed to be able to assist in mastering biology material.

Design

Learning Device Design

      The design of the circulation system e-module learning device developed consists of three learning materials. The design of circulation system e-module learning devices can be seen in Table 3.

Table 3. Basic competencies and learning materials for circulation system materials

Basic competency	Meeting learning	Materials/Meetings
3.6 Analyzing the relationship between the structure of the organ-composing tissue in the circulatory system in relation to bioprocesses and functional disturbances that can occur in the human circulatory system. 4.6 Presenting papers on abnormalities in the structure and function of the blood, heart, blood vessels that cause disturbances to the human circulatory system and their relation to technology through literature studies.	1	Blood Components and Blood Type
	2	Circulatory Instruments
	3	Circulatory Mechanisms and Circulatory System Disorders and Abnormalities

E-module Design

      The learning cycle 8e-based circulation system e-module format was designed using a professional flip pdf application (Arsal et al., 2019: 435). The design format of the e-module is shown in Figure 2. In general, the designed e-module format consists of a cover, preface, table of contents, introduction, learning activities, evaluation, glossary and bibliography, while the conclusions are contained in each learning activity.

Figure 2. Learning cycle 8E based circulation system e-module format (Modification of the Ministry of National Education, 2017)

Development

Making E-Modules

The development stage is the stage of designing the circulation system e-module that has been designed, where the material is in accordance with curriculum 13. The e-module is developed on circulation system material with the help of a professional flip pdf application. This application is easier to use for beginners and teachers who don't really understand the HTML programming language (Rara et al., 2019).

E-Module Validation

Validation is carried out to determine the quality of the e-modules developed and used to gain recognition that the modules developed are in accordance with the needs of learning activities. Validation uses a Likert scale questionnaire sheet which consists of 3 assessment aspects, namely didactic, construction, and technical aspects (Ma'as et al., 2013). Validation was carried out by one material expert, one media expert, and one pedagogic expert. The description of the validation results of each aspect is as follows;

Didactic Aspect

The didactic aspect is associated with learning, conceptual and feasibility principles in terms of the learning material presented in the e-module (Zulfarina et al., 2021). The didactic aspect consists of 13 questions at each meeting in the e-module. The results of improvements from three experts on the didactic aspects of the developed e-module are as follows;

Improvement in determining learning objectives

Improvements to the learning objectives in the circulation system e-module are shown in Figure 4. These improvements were found from the comments of the experts. The learning objectives contained in the e-module were initially presented not in accordance with the learning cycle 8e model, so improvements were made and adjusted to the stages of learning cycle 8e.

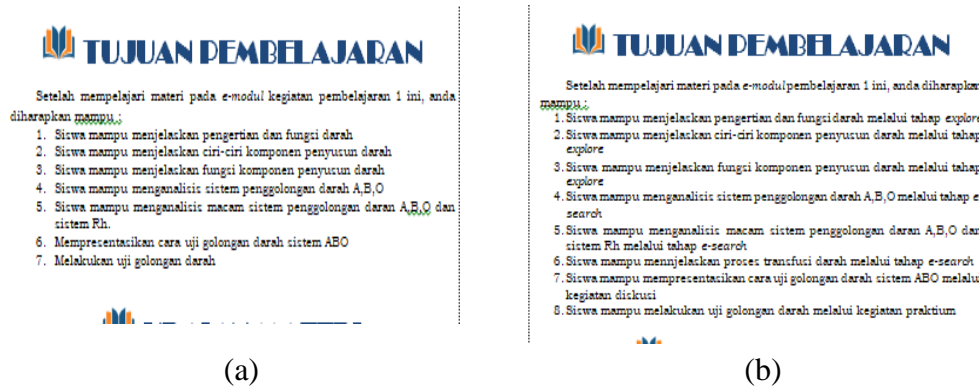(a)   (b)

Figure 3. Before (a) and after (b) improvements to the learning objectives of the circulation system e-module

Improvement on blood understanding

Improvements before and after the concept of understanding blood is shown in Figure 6. Initially the meaning of blood was mentioned based on its function, such as "in growing humans there is a fluid that functions as a means of transportation". This definition was ordered to be replaced with a more specific definition. Then the definition of blood has been corrected as shown in Figure 6.
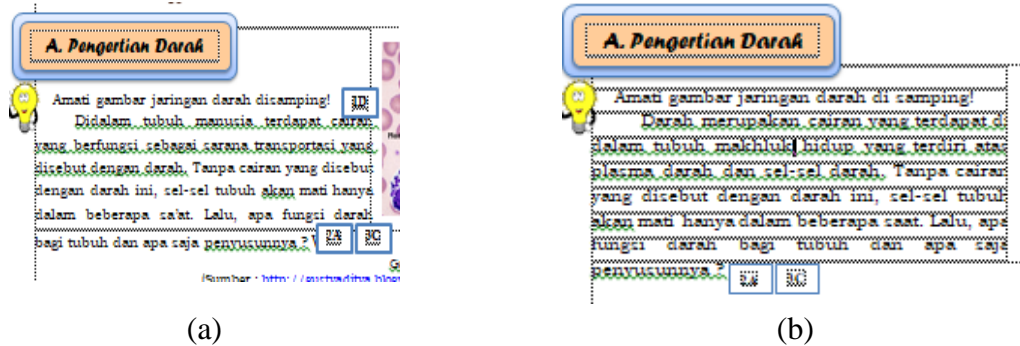

| (a) | (b) |

Figure 4. Before (a) and after (b) improvements to the presentation of material in the circulation system e-module

Meanwhile, the results of the validator's assessment of the e-module circulation system based on learning cycle 8e on the didactic aspect are summarized in Table 4.

Table 4. Assessment of e-module circulation system based on learning cycle 8e on didactic aspects

No.	Question item	Percentage average (%)		
		MP I	MP II	MP III
1	The material in the e-module is in accordance with basic competencies	91,67	100	91,67
2	Each question contained in the e-module corresponds to the indicator to be achieved	100	100	91,67
3	The material in the e-module is in accordance with the learning objectives	100	100	100
4	Accuracy of concepts and definitions	100	100	100
5	Accuracy of actual and factual material	100	100	100
6	Accuracy of pictures, illustrations and videos	91,67	83,33	91,67
7	Consistency in use of terms	91,67	75	83,33
8	Encourage curiosity	91,67	91,67	83,33
9	Creates the ability to ask questions	91,67	100	100
10	Activities in the e-module help students understand the concept of a circulation system	91,67	100	100

11	Activities in the e-module provide insight into students	91,67	100	100
12	Activities in the e-module help stimulate students' critical	83,33	100	100
13	Every question contained in the e-module helps stimulate students' critical thinking	91,67	100	83,33
	Score average	93,59	96,15	94,23

Note: MP I = learning material I, MP II = learning material II and MP III = learning material III

The average score of the total percentage of validation results on learning material I is 93.59%, learning material II is 96.15%, and learning material III is 94.23%. Based on the product eligibility criteria according to Riduwan (2012), it was found that the feasibility criteria for learning material analysis I, II and III were in the valid category. According to Panji (2015), the didactic requirements of a teaching material that are assessed for the feasibility of presenting the material and used in learning activities must be in the valid category. This aims to carry out the learning process effectively and there is no longer any doubt about the material of the product.

The e-module integrated with the learning cycle 8e model has been validated with a valid category. In addition, the advantages developed are learning based on constructivism learning, or based on real experiences that ask students to relate the knowledge learned to daily activities (Ngalimun, 2012). This can contribute to an increase in building independent learning concepts through learning using this circulation system e-module. According to Rini et al., (2020), who have developed an e-module based on ex-learning, it is stated that the truth of the substance presented in the didactic aspect is necessary so that there are no misunderstandings among students

Construction Aspect

The construction aspect relates to the use of language, sentence structure, vocabulary, sentence clarity and the accuracy of the presentation of the stages of learning cycle 8e in the e-module. The construction aspect contains 21 questions of information. The results of improvements from experts on construction aspects in the circulation system e-module are as follows:

The use of language in the introduction

Initially, the introductory language used was too general and did not explain the e-module in detail. After making improvements to the introductory words, it explained the topics discussed in the e-module in detail. The image of the repair of the circulation system e-module introduction is shown in Figure 7
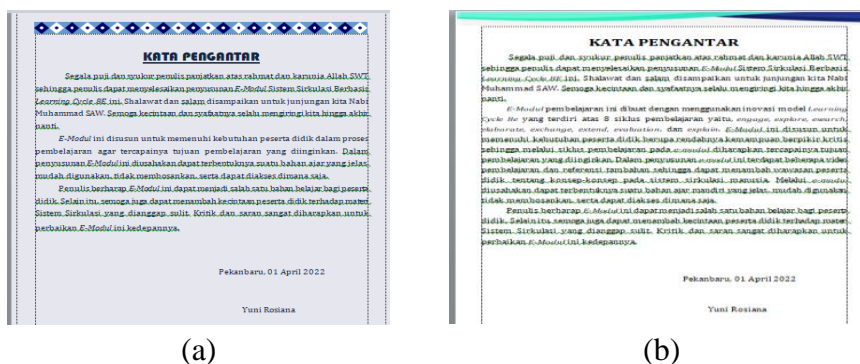
(a)   (b)

Figure 5. Before (a) and after (b) improvements to the preface to the circulation system e-module

Improvements to the preparation of the table of contents

At first the size of the letters in the table of contents was too small, too dense and then the color of the letters was too varied, so corrections were made to make the table of contents easier and more comfortable to read. Improvements to the table of contents for the circulation system e-module are shown in Figure 8.

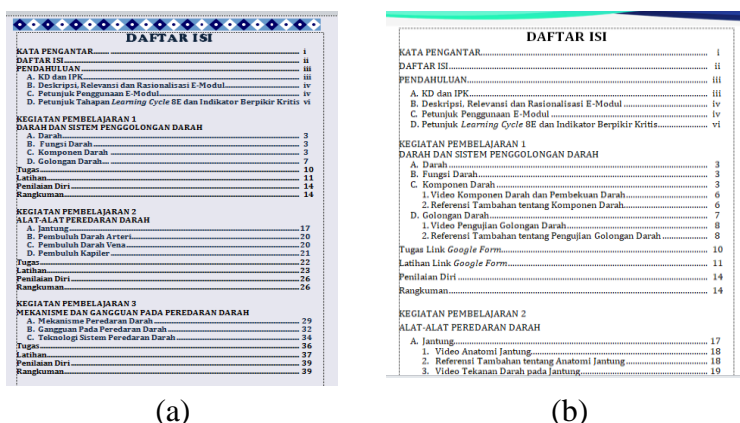(a)   (b)

Figure 6. Before (a) and after (b) improvement to the table of contents of the circulation system e-module

Following are the results of the validator's assessment of the learning cycle 8e-based circulation system e-module on the construction aspect can be seen in Table 5

Table 4. Assessment of e-module circulation system based on learning cycle 8e on construct aspects

No.	Question item	Percentage average (%)		
		MP I	MPII	MPII
1	Use the correct grammar rules	83,33	83,33	83,33
2	Use simple and clear sentences	91,67	83,33	83,33
3	Spelling accuracy	83,33	91,67	83,33
4	Grammar usage	83,33	91,67	91,67
5	The material is presented systematically	91,67	91,67	100
6	The accuracy of sentence structure and language is easy to understand	83,33	100	91,67
7	Material according to the level of student ability	91,67	91,67	91,67
8	The clarity of the material description of the circulation system	91,67	91,67	91,67
9	Coverage of material related to sub-themes	100	91,67	91,67
10	The images used are in accordance with the material	91,67	100	100
11	Display sample images presented interesting	91,67	91,67	100
12	The stages of the 8e learning cycle model appear in the learning activities in the e-module	100	91,67	100
13	Integrating the engage stage of the e-module	100	100	100
14	Integrating the explore stage of the e-module	100	100	100
15	Integrating the esearch stage of the e-module	100	100	100
16	Elaborate stage integration of e-modules	100	100	100
17	Integrating the exchange stage on the e-module	91,67	100	100
18	Integrating the extend stage on the e-module	91,67	100	100
19	Integrating the evaluate stage on the e-module	91,67	100	100
20	Integrating the explain stage of the e-module	91,67	100	100
21	E-module circulation system based on learning cycle 8e stimulates students' critical thinking	91,67	83,33	100
	Score average	92,46	94,44	95,63

Note: MP I = learning material I, MP II = learning material II and MP III = learning material III

The average score of the total percentage of validation results on the construction aspect of learning material I was 92.46%, learning material II was 94.44%, and learning material III was 95.63%. Based on the product eligibility criteria according to Riduwan (2012), the feasibility criteria for the analysis of learning materials I, II and III are in the valid category.

The use of correct language rules is an important component in preparing teaching materials so that students do not make mistakes, according to Martha (2018) the rules for using language are related to the use of clear sentences and do not cause misinformation received by students.

Technical Aspect

The technical aspect discusses the appearance of the e-module product including the various types of text used, color display and others. On the technical aspect consisting of 16 questions, the results of improvements from experts on construction aspects are as follows;

Repair on cover

Initially the title on the cover is not neatly positioned, this will make it difficult for the reader when using the e-module and repairs are made. Improvements to the cover of the circulation system e-module are shown in Figure 9. The writing of the title on the front page of the e-module has been neatly arranged, this is in accordance with comments and suggestions from material and media experts.

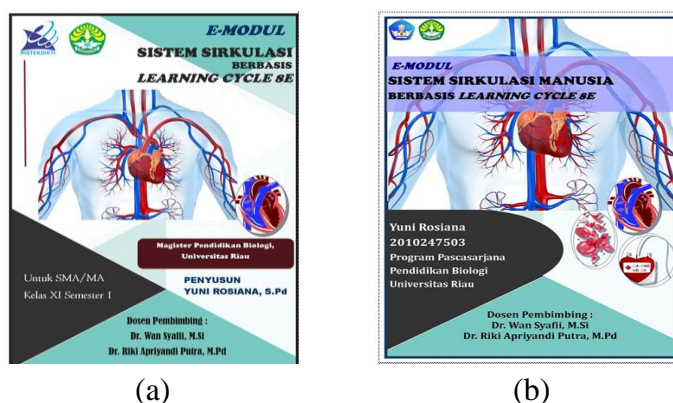(a)   (b)

Figure 7. Before and after repairs on the appearance of the circulation system e-module cover

E-module design improvements

Initially the design used in the introduction section used a batik frame and a blue background, but because this design was uncomfortable to look at and the background was a bit dark. So, improvements were made to the design and background in the introductory part of the e-module. Changes in the background color of the circulation e-module are represented in the table of contents section, shown in Figure 10

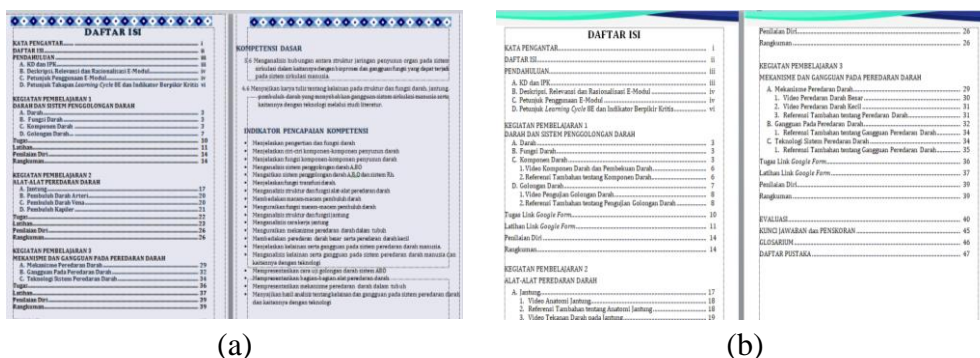(a)   (b)

Figure 8. Before (a) and after (b) Design improvements to the table of contents

The results of the validator's assessment of the e-module circulation system based on learning cycle 8e on the construction aspect can be seen in Table 6.

Table 6. Learning cycle 8e based circulation system e-module assessment on technical aspect

No.	Question item	Percentage average (%)		
		MP I	MPII	MPIII
1	Display on the cover of the e-module	83,33	83,33	83,33
2	Don't use too many font combinations.	83,33	75	83,33
3	The cover illustration for the e-module describes the content/teaching materials and reveals the character of the object.	91,67	75	83,33
4	Image sharpness	91,67	91,67	91,67
5	The separation between paragraphs is clear.	100	100	100
6	Spacing between text and illustrations is appropriate.	91,67	100	100
7	Title of learning activities, subtitles of learning activities, and page numbers.	91,67	100	100
8	Placement of ornaments/illustrations as a background does not interfere with the title, text, page numbers.	83,33	100	100
9	The placement of titles, subtitles, illustrations and captions does not interfere with understanding	83,33	100	91,67
10	The use of variations of letters (bold, italic, all capital, small capital) is not excessive.	83,33	100	91,67
11	Spacing between lines of normal text arrangement.	91,67	91,67	100
12	Spacing between letters is normal.	91,67	91,67	100
13	Ease in operating the e-module	83,33	100	91,67
14	Simplicity of visual design	83,33	91,67	100
15	Sound/dubbing quality.	83,33	83,33	83,33

16	Suitability with students' ability to operate e-modules	91,67	100	100
	Score average	87,49	92,60	93,75

Note: MP I = learning material I, MP II = learning material II and MP III = learning material III

The average score of the total percentage of validation results of technical aspects in learning material 1 is 87.49%, learning material II is 92.60%, and learning material III is 93.75%. Based on the product eligibility criteria according to Riduwan (2012), the e-module eligibility criteria on technical aspects in learning materials I, II and III are in the valid category. According to Rona (2017) The technical requirements for a teaching material include the use of the type of writing, image display, color and the appearance of the e-module which are appropriate and can attract students' attention to reading the e-module.

The results of the overall validity of all learning materials in all didactic, construction and technical aspects are summarized in Table 7.

Table 7. Overall validity results

No.	Aspect validation	Percentage (%)				
		MPI	MPII	MPIII	Average	Category
1	Didactic	93,59	96,15	94,23	94,65	Valid
2	Constructs	92,46	94,44	95,63	94,17	Valid
3	Tecnichal	87,49	92,60	93,75	91,28	Valid

Based on Table 7, the didactic aspect that has the highest validity value is learning material II of 96.15%, the construction aspect which has the highest validity value is learning material III of 95.63%, while the technical aspects are found in material learning III of 93.75%.

CONCLUSION

Based on the results of the analysis of teaching materials it was found that the teaching materials used were in the form of printed books, and material analysis found that the circulation system material was far from the KKM value. Meanwhile, the e-module has been validated by three material, pedagogic, and media experts. Validation was carried out on three aspects, namely didactic, construction, and technical aspects. The values obtained from the validation results for these three aspects are valid categories. Meanwhile, for the next lesson, the researcher will apply an e-module circulation system based on learning cycle 8e in learning activities so that it can help students learn independently.

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