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Student responses to the electronic module of the circulatory system

Syafira Amelia*, Ruqiah Ganda Putri Panjaitan, Eko Sri Wahyuni
Department of Biology Education, Faculty of Mathematic and Natural Science
Universitas Tanjungpura, Jl. Prof. Dr. H. Nawawi, Pontianak, West Kalimantan, Indonesia
Corresponding author: *syafiraamelia23@gmail.com

ABSTRACT

The use of electronic teaching materials could increase students' interest in learning. An electronic module was one of the teaching materials. This study aimed to see the feasibility of the electronic module material for the circulatory system. We used the research and development method. This study's method had steps that included potential and problems, data collection, product design, design validation, design revision, and product testing. Five validators validated product design. The data analysis used the CVR and CVI values for each criterion in the validation aspect which are course, graphic, contents, and language with a minimum value of 0.99. The study found two important findings. First, from the validator, the CVR values in all elements had a value of 1, and the CVI results each had a value of 1. Hence, the electronic module of the circulatory system material is declared valid and feasible to use. Second, the product trial obtained an overall average score of 88.4% and was very positive. It means that the electronic module could be an alternative teaching material used in the learning process at school or self-study for the student at home.

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INTRODUCTION

Learning is a process consisting of a combination of two aspects, learning that is directed at what students must do and learning that is oriented to what the teacher must do (Yulando et al., 2019). The learning process will be effective in education if communication and interaction between teachers and students occur intensively. The method of exchanging information on learning in the classroom occurs during the delivery of learning materials (Inah, 2015). Supporting factors in the teaching and learning process include media and teaching materials. Teaching material often referred to as subject matter, is the most crucial part of the learning process. The subject matter is the core of learning activities (Richmond et al., 2017). Teaching materials are an essential source of material for teachers in carrying out the learning process. Teaching materials can assist teachers in achieving learning objectives. Teachers must always prepare appropriate teaching materials to implement the learning process (Bhalla, 2013). Teaching materials should be designed in such a way as to assist teachers in planning and implementing quality teaching

processes and learners with their independent learning, i.e., acquiring, revising, reflecting on, assessing, and using knowledge (Mazgon & Stefanc, 2012).

Learning about the human circulatory system is important in biology. Not least because it is a crucial human physiological system, it is also important because understanding the system is a key to the learning of other important biological concepts, for example, the transport and exchange of materials in the human body, gaseous exchange, and the lymphatic system. An understanding of cardiovascular disease and its treatment is also based on concepts related to the circulatory system (Cheng & Gilbert, 2015). Some of the circulation system learning is done through 3D media with visual impairment (Yazici & Sözbilir, 2022), circulation models (Kern, 2013), Adobe Flash CS6 (Anggraini et al., 2019), and augmented reality interactive cards (Indahsari et al., 2021). These learning media are good for use in circulation learning with all the advantages and disadvantages of each. However, in the current technological era, electronic-based learning media are needed.

Electronic learning devices can improve the quality of student learning (Yanuschik et al., 2015). Computers have an essential role in learning in today's modern era, increasing students' interests, attitudes, and motivation in the learning process (Kristanto et al., 2016). Electronic teaching materials use computers in their operation. Teaching and learning activities using electronic teaching materials can be in the form of electronic modules or e-modules. Learning by using an e-module is expected to attract students' attention. E-module is the module in an attractive electronic format (Resita & Ertikanto, 2018). Development of learning modules intended for self-learning students, so that with the given module to assist in motivating students can learn and improve learning outcomes of the students themselves (Perdana et al., 2017).

An e-module is a learning tool or tool that can contain materials, methods, limitations, and ways of evaluating designed systematically and attractively to achieve the expected competencies (Rochsun & Agustin, 2020). E-modules can contain multimedia, so that can text, images, animations, and videos through computer devices. Using the e-module can be efficient and interactive in learning (Irwansyah et al., 2017). They use multimedia to minimize the number of intrinsic and extrinsic cognitive loads to facilitate the externalization of information thinking, memorizing, and processing of information (Wilsa, 2019). Learning content becomes more dynamic, effective, and fun. The use of multimedia can increase the level of learning outcomes (El-Sofany & El-Haggar, 2020). Electronic modules as digital teaching materials must meet eligibility qualifications in terms of validity, applicability, practicality, presentation, and legibility as teaching materials (Prasetya, 2021).

According to Laili et al. (2019), the advantages of using e-modules are: (1) Growing students' learning motivation, (2) Knowing the level of mastery of the material through evaluation tests, (3) Sorting out learning materials according to the competencies that students must achieve, (4) Improving student performance because the module is more exciting and interactive, (5) Reducing the high verbal element because it can contain video, audio, and animation in the module.

The use of e-modules in the learning process can increase motivation and students' (Oksa & Soenarto, 2020) analytical skills, with the results of the percentage of student responses stating that e-modules are suitable for use in learning (Maisaroh et al., 2020). Other reasons such as the

development of e-modules are: (1) Their use can facilitate learning and improve the quality of learning, (2) They attract students' attention, (3) Support student learning independence, and (4) They contain learning objectives and material limitations to help direct student learning, (5) Familiarize students with computers, and (6) the attractiveness of e-modules due to the facilities of colour, audio, images, graphics, and animation (Zaharah et al., 2017).

The learning tools can be made based on experience or research results (Panjaitan et al., 2021). Scientific research by learning materials can show the relationship between biological sciences and the surrounding environment. For example, we are developing textbooks based on research on spider species on biodiversity material (Suwarni, 2015), and creating a module-based can increase learning motivation and phytoplankton research on protists (Latifa, 2021). Although research related to the development of e-module for learning biology has been widely studied, the present study tries to address the gap regarding the development of e-module on circulation system material suitable for use in high school.

Student response at the end of the lesson is necessary to determine the effect of media or teaching materials arranged in the learning process as a reflection. One reflection type is the student's response to the media or teaching materials during learning. Student responses help consider improvements in designing the learning process (Humaidi et al., 2021). Student responses are students' responses and reactions during learning (Aisyah et al., 2016). They are essential in teaching and learning activities (Arini & Lovisia, 2019). The enjoyable learning makes students more motivated to participate in education. It makes it easy to absorb the knowledge conveyed, as seen in students' responses to anticipating the learning process. Response means a reaction or response in the form of acceptance, rejection, or indifference to the message from the communicator. The student's response can be in the form of a negative or positive response.

The response consists of three parts: cognitive, affective, and conative (Amir, 2017). Cognitive is a response closely related to a person's knowledge, skills, and information about something that can appear if there is a change in what the audience understands or perceives education. Affective responses related to emotions, attitudes, and judging someone to something can arise if there is a change in what the audience likes about something. While conative, responses related to actual behavior, includes actions or habits. The student responses determine what students need in learning (Anton, 2018). The responses given by students can produce the expected changes in attitudes, both cognitive, affective, and psychomotor attitudes.

This study aims to determine the feasibility of the e-module developed on the circulatory system material for class XI High School and see the students' responses to the e-module. The e-module was developed based on the benefits test of red dragon fruit peel extract (*Hylocereus polyrhizus*) on blood LDL cholesterol levels associated with disorders and disorders of the circulatory system. E-module on the circulatory system can be an alternative learning material in the digital era that can be used in offline and online classes.

METHOD

The research was conducted as a research and development methods. The product developed

is an electronic module for learning biology on circulatory system material that can be used as alternative teaching materials for class XI High School students. This study used six procedures that refer to Sugiyono (2015), namely: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design improvement or revision, and (6) limited-scale product trials.

At the potential and problem stage, we were observations made at three schools in Pontianak City. We were interviews conducted with three high school biology teachers in Pontianak City during data collection. In product design, there are several steps in compiling this e-module: (1) Previously, compiled material based on research on red dragon fruit peel's potential on blood LDL cholesterol has been done. (2) It collected references as the basis for writing material in e-modules. (3) It identified essential competencies and basic materials in the syllabus. (4) It identified indicators of competency achievement and designed the assessment forms and types that will be presented. (5) We designed the format for writing the e-module, compiling the material on the e-module according to the competency achievement indicators using Microsoft Word. (6) We added animation and video using the Kvsoft flipbook maker pro application.

The aspects of the module teaching materials that will be validated modify those from Hamdani (2011) and Depdiknas (2008), namely the presentation, content, graphics, and language. The module validation consists of four assessment criteria based on a Likert scale, namely Very Good (SB) is worth 4, Good (B) is worth 3, Less (K) is worth 2, and Very Poor (SK) is 1. After validation, scattering or revision is carried out based on advice from the validator. Furthermore, finally, a limited-scale product trial was carried out by looking at the student's responses to the electronic module of the circulatory system.

Analysis of the data validation results refers to Lawshe (1975) by calculating the value of the content validation ratio (Content Validity Ratio/CVR). After obtaining the CVR value from each criterion, the CVI (Content Validity Index) value is calculated to illustrate that the overall instrument has good content validation. The calculation of CVR is as follows:

$$\text{CVR} = \frac{Ne - \frac{N}{2}}{\frac{N}{2}} \qquad (1)$$

Where CVR is the Content Validity Ratio, Ne is the number of validators who agree on the validity of the media, and N is the total number of validators.

After the results of the calculation of the CVR value for all criteria are obtained, then the CVI (Content Validity Index) value is calculated with the formula:

$$\text{CVI} = \frac{\sum \text{CVR}}{\sum \text{N}} \qquad (2)$$

Where CVI is the Content Validity Index, CVR is the Total CVR of all criteria, and N is the number of measures.

Product trials on students were carried out by looking at the student's responses to the electronic module of the circulatory system. The product trial was limited to three High School level schools in Pontianak City, which were selected using a simple random sampling technique. At this

stage, a limited trial was conducted by giving a response questionnaire to nine students from three preferred schools. Students' response to learning is divided into three aspects. Namely, the answer is cognitive, affective, and conative (Amir, 2017). The response questionnaire consists of positive and negative statements, analyzed using a Likert scale.

For each statement item, the percentage will be calculated, and the criteria for each aspect will be determined with an interpretation referred to by Riduwan (2007) in Table 1.

Table 1.   The criteria for the each aspect of e-module

Category Percentage	Range
0% - 20.99%	Very weak
21% - 40.99%	Weak
41% - 60.99%	Enough
61% - 80.99%	Strong
81% - 100%	Powerfull

Determine the response category given by students by matching the results of the average percentage of all criteria with positive criteria according to (Yamasari, 2010) in Table 2.

Table 2. The positivity category for the student response

Percentage Range	Category
85% ≤ PR	Very positive
70% ≤ PR < 85%	Positive
50% ≤ PR < 70%	Less Positive
PR < 50%	Not Positive

RESULTS AND DISCUSSION

The developed circulatory system electronic module contains material adapted to the K-13 syllabus. The material contained in the e-module, namely parts of blood, blood type, blood clotting, blood circulation devices, blood circulation processes, and abnormalities that may occur in the circulatory system, as well as efforts to maintain the health of the circulatory system. was developed based on research on the effect of red dragon fruit peel extract (*Hylocereus polyrhizus*). E-module are also equipped with formative tests and student worksheets for each part of the learning material in the e-module to support independent learning activities. The development of the circulatory system material on the e-module is intended as an alternative teaching material that can be used by teachers and students in the learning process at school as well as independent learning.

Five validators carried out the validity test of the circulatory system electronic module. According to Nafsiah et al. (2019), the purpose of the validation is to see the feasibility of the learning device based on the experts' assessment. Four aspects are assessed: presentation, graphics, content, and language. Analysis of the validation sheet using the Lawshe formula (1975) on five validators with a minimum CVI value of 0.99 is categorized as valid.

Based on Table 3 of the validation analysis of the electronic circulatory system module, the CVR value of all criteria in the four aspects got a deal of 1. According to experts, the CVI value was one in all aspects. The electronic module was categorized as valid or suitable because the CVI value has exceeded the minimum requirement of 0.99.

Table 3. The results of the analysis of the validation of teaching materials for the electronic circulatory system module
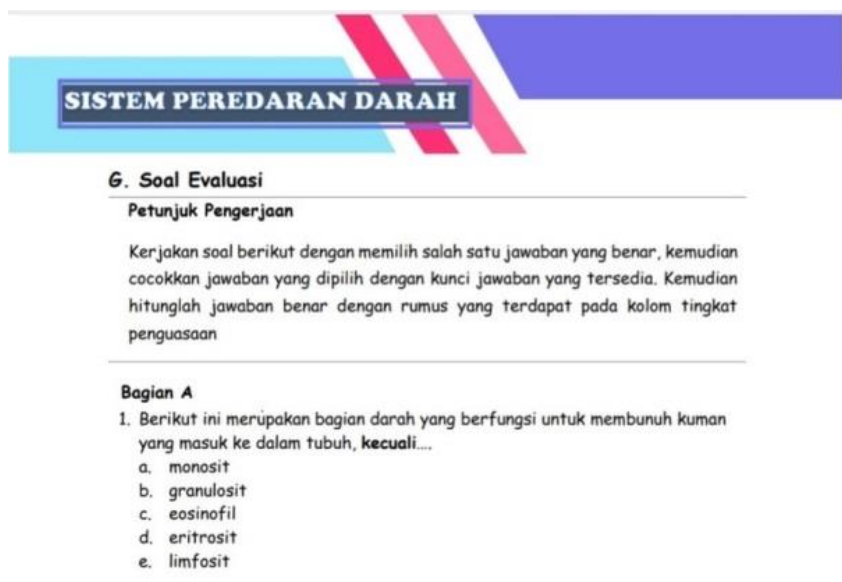
Aspect	Criteria	Validator					CVR	Info
		1	2	3	4	5		
Course	Presentation of the electronic module start page	4	4	4	4	4	1	Valid
	Presentation of Core Competencies (KI) and Basic Competencies (KD)	4	4	4	4	4	1	Valid
	Presentation of Competency Achievement Indicators (GPA)	4	3	4	4	4	1	Valid
	Presentation of learning objectives	4	3	4	4	4	1	Valid
	Presentation of material descriptions and examples	4	4	4	3	4	1	Valid
	Presentation of formative tests and evaluations	4	4	4	4	4	1	Valid
	Presentation of answer keys	4	4	4	4	4	1	Valid
	Summary presentation	4	4	4	4	4	1	Valid
	Presentation of feedback and follow-up	4	4	4	4	4	1	Valid
	Glossary presentation	4	4	4	4	4	1	Valid
	Presentation of the components of the bibliography	4	4	4	4	4	1	Valid
Graphics	Layout	4	4	4	4	4	1	Valid
	Module display attractiveness	4	4	4	3	4	1	Valid
	The legibility of the shape and size of the letters used in the module	4	4	4	4	4	1	Valid
	Consistency	4	3	4	4	4	1	Valid
Contents	Information on the material is *self-contained*	3	4	4	3	4	1	Valid
	The content of the module is *self-instruction*	4	4	4	3	3	1	Valid
	Conformity of examples, pictures, and illustrations with the content of the material	4	4	4	4	4	1	Valid
	Research information on an ethanol extract of red dragon fruit peel (*Hylocereus polyrhizus*) to reduce blood LDL cholesterol levels in hypercholesterolemic mice in the module.	4	4	4	4	4	1	Valid
Language	PUEBI compatibility	3	3	4	4	3	1	Valid
CVI							**1**	

In the presentation aspect, there are 11 criteria, all of which get a CVR value of 1. These criteria include presenting the initial page or cover, which contains the title of the e-module material, school, grade levels, and images related to the material with attractive colours and contrasting

writing so that easy to read. The cover is more attractive, so displaying images, colour combinations, and matching font sizes is recommended (Magdalena et al., 2020). Other criteria are the presentation of KI, KD, GPA, learning objectives, and materials and examples adapted to the learning syllabus. Production of formative and evaluative tests and feedback and follow-up to measure how students understand the material being studied in the e-module. Presentation of answer keys, summaries, glossaries, and bibliography as a complement to the contents of e-modules that support students' independent learning. The cover layout view, it is presented in Figure 1. The evaluation sheet is shown in Figure 2. This module is also equipped with special information about the benefits of fruit peels which can be seen in Figure 3.

Figure 1. The e-module home page displays the title, material, level, and author's name, equipped with animations and navigation buttons

(a)

(b)

Figure 2. (a) Evaluation questions and (b) The level of mastery used to measure the participants' mastery of the material.

Figure 3. Information on the benefits of red dragon fruit peel extract in lowering blood LDL cholesterol levels and maintaining healthy blood vessels.

In the aspect of content, there are four criteria: namely information on the material is self-contained, the content of the module is self-instructional, and the suitability of examples, pictures, and illustrations with the material's content as well as research information on the results of testing the effect of ethanol extract of red dragon fruit peel (*Hylocereus polyrhizus*) to lower cholesterol levels. Blood LDL of hypercholesterolemic mice. The results of this study indicate that all these criteria get a CVR value of 1. The modules must-have criteria for self-contained and self-instruction (Muldiyana et al., 2018). Self-contained means that all learning material being studied is contained in one module. Students can learn the material entirely because the material is packaged into a unified whole, and self-instruction means the module can facilitate students in independent learning.

In the language aspect with the criteria for conformity with PUEBI, the CVR score is 1, which indicates that the words used in the e-module are by linguistic rules and appropriate punctuation marks. Communicative language and linguistic rules can make it easier for students to learn and understand the content and material in the developed module (Reznani et al., 2021).

After validating and revising the design of the circulatory system electronic module, the next step is product testing. We conducted the product trial limitedly using nine students of class XI High school students. The instrument of this research is a response questionnaire. The response questionnaire consiststings of three aspects, cognitive, affective, and conative. The determination of this aspect refers to Amir (2017). There are indicators with 12 statements divided into positive and negative comments, calculated as the average percentage, and analyzed using a Likert scale that refers to Riduwan (2015). Based on Table 2, the average response percentage is 88.4%, with a powerfull category.

Table 4. Results of questionnaire analysis of student responses to electronic module teaching materials

Aspect		Indicators	Value (%)	Average (%)
Cognitive	1.	Ease of understanding the contents of the e-module	86.67	
	2.	Students' perceptions of the appearance of the e-module	91.12	88.52
	3.	Students' perceptions of the questions presented	87.78	
Affective	4.	Students' interest in e-modules	86.56	
	5.	Curiosity	81.11	83.34
Conative	6.	Tendency to make applications in everyday life	93.33	93.33
		Average Response		88.40

The first aspect seen is the cognitive aspect, wich gets an average percentage value of 88.52%, with a very high category. In this aspect, there are three indicators: the ease of understanding the content of the e-module, students' perceptions of the appearance of the e-modules, and student's perceptions of the questions presented. In the first indicator of this aspect, which is about the ease of understanding the contents of the e-module, the percentage value obtained is 86.67%, with a

powerfull category. It indicates that the e-module uses communicative language and the material presented in the e-module makes students understand more about the material of the circulatory system. In the second indicator, namely students' perceptions of the e-module display, the percentage value obtained is 91.12%, with a powerfull category. It indicates that the e-module presents images from the learning material with a harmonious mix of colors and the appropriate size of writing. So, the e-module can be read correctly. In the second indicator, namely the students' perception of the appearance of the e-module, the percentage value obtained is equal to 87.78%, with a powerfull category. It indicates that the questions presented in the e-module help students determine the extent to which students understand learning, especially on the material of the circulatory system.

The third aspect is conative with the categories contained in this aspect, namely the tendency to apply it in everyday life. The percentage obtained for this category is 93.33%, with a very high category. It shows that the additional material and information in the e-module enables students to relate learning materials to everyday life and apply a healthy lifestyle to maintain a healthy circulatory system.

CONCLUSION

Based on the research, the validation analysis results are obtained with the CVR and CVI values of 1. These values have met the Lawshe minimum limit for category five validators with a minimum CVR and CVI value of 0.99. We can conclude that the electronic circulatory system module developed can be categorized as valid or feasible to use. Based on the response test conducted on students, the average for each assessment aspect was 88.4%. The electronic circulatory system module in learning received a very positive response. So for further researchers, it is hoped that they can continue research to the final stage, namely mass production.

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