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Edmodo mobile: developing e-module on biology cell for online learning community

Nuril Hidayati*, Ardian Anjar Pangestuti, Trio Ageng Prayitno

Biology Education, Institut Keguruan dan Ilmu Pendidikan Budi Utomo, Malang, Indonesia.

*Corresponding author: hidayatinuril20@gmail.com

A R T I C L E   I N F O

A B S T R A C T

Observation result in cell biology (CB) learning showed that most students assumed cell biology as a complex and abstract material. The level of conceptual understanding was still relatively low observable from inadequate test results. Misconception on cell structure as a dense and non-porous structure was reported; this can be seen from students' drawing on cell membranes. One solution to overcome the above problem was to develop contemporary teaching materials in the form of e-module based on Edmodo mobile (based android) so that students can easily access them by their smartphone. The research objective was to develop an Edmodo android cell biology module. Research and development (R&D) method were applied in this study. The development model used was Thiagarajan 4D, which is defined, design, and develop. The instruments used were the e-module validation questionnaire by experts (material and media experts, practitioners) and the feasibility test questionnaire on 24 students. The result showed that Edmodo mobile on CB developed through Thiagarajan 4D has valid criteria. Thus, it can be used in cell biology learning.

INTRODUCTION

Students of biology education, Institut Keguruan dan Ilmu Pendidikan (IKIP) Budi Utomo Malang as one of higher education institutions should master professional, pedagogic, social, and personal competencies. Graduates' achievement in cell biology (CB) course includes the ability to define and describe cell structures and functions (Hanik, 2016; Juliana, Amin & Suarsini, 2016; Hartati & Safitri, 2017). Content in CB course is taught in junior (SMP) as well as senior high schools (SMA) in a subject about the smallest unit cells making up the organism (Saptono, Rustaman, & Widodo, 2013; Rosamsi, Miarsyah, & Ristanto, 2019). CB concept is one essential part of being

mastered by students as a prospective teacher to improve their professional competence (Tanner, Chatman, & Allen, 2003; Allen & Tanner, 2003; Safitri & Hartati, 2016; Rosamsi, et al., 2019).

Based on the observation result in cell biology learning, most students assumed that CB as a complicated and abstract subject (Safitri & Hartati, 2016; Hartati & Safitri, 2017). The conceptual understanding level was low indicated by inadequate test result. There was a misconception on cell structure as a solid and non-porous structure. The misconception was showed in students drawing result in cell membrane topic. CB is a basic course and pre-requisite course for other classes in the Biology Education; hence, concept mastery in the course is vital (Hanik, 2016; Juliana, et al., 2016; Saptono, et al., 2013).

Due to the importance of CB concept mastery, lecture activities should be conducted effectively and efficiently according to the National Qualification Framework (KKNI) curriculum (Juliana, et al., 2016; Hartati & Safitri, 2017). This course learning activities performed merely through theoretical lecture must be optimized; so that it is following graduate achievement required in the course (Hanik, 2016; Juliana, et al., 2016; Saptono, et al., 2013). Learning should be designed as best as possible to achieve learning objectives (Darmawan, Brasilita, Zubaidah, & Saptasari, 2018; Djamahar, et al., 2019; Lestari, Ristanto & Miarsyah, 2019a). One of the improvement solutions is the development of a teaching material that supports learning activities (Dewi, Nilawarni, & Rusdi, 2015; Ichsan, Rusdi, Sartono, 2017; Supriyatin & Ichsan, 2018). According to Hendripides & Hikmah (2018), teaching material is an information source used by a lecturer to implement a learning process. The teaching materials can be presented in the form of printed and non-printed media (Suryanda, Ernawati & Maulana, 2016; Isfaeni, Corebima, Suwono & Rohman, 2018; Toy et al., 2018; Supriyatin & Ichsan, 2018). The developed teaching material should be current and can be applied in the form of mobile learning (Suryanda, et al., 2016; Prayitno & Hidayati, 2017; Hursein, 2018); hence, e-module is selected. E-module is a teaching material produced according to the graduate's achievement on cell biology in KKNI curriculum. The form was electronic and can be accessed using students' smartphone. E-module developed in this study can be accessed by students with mobile learning of Edmodo android (Prayitno & Hidayati, 2017; Hursein, 2018; Hidayat, Lufri, Handayani, & Darussyamsu, 2019). Edmodo is a social media learning application which makes CB material is more comfortable to be learned, and it makes them interact with each other in an online platform. Hence, they are not only pent up in the classroom.

Moreover, Edmodo has a platform which provides CB material to be uploaded, feedback to be practiced, and interactive discussion to occur. This application can be opened easily by using students' Android phone. Information technology plays a significant role in learning, which provides a meaningful experience for students. Information technology can be stated as a useful tool for students to understand a concept (Candy & Lasaten, 2017; Rosamsi, et al., 2019; Lestari, Ristanto, Miarsyah, 2019b).

The module is one of the systematic teaching materials and contains planned learning activities, made to assist students in mastering certain graduate achievement (Marzuqi & Sihkabuden, 2016; Fitriani, Amelia, & Marianingsih, 2017). Since the developed module is in electronic form, it is called e-module (Suryanda, et al., 2016; Hidayat, et al., 2019). Content in the e-module creates more learning experiences for students. Also, the learning activities contained in the e-module could activate and develop students' thinking ability. The developed e-module will be integrated into mobile learning, such as Edmodo android (Purwaningtyas, Dwiyogo, & Hariyadi, 2017; Utami, Nugroho, Dwijyanti, & Sukarno, 2018). Edmodo apps is a safe, educational, social media for learning activities performed by a lecturer. Edmodo is easy to use directly with smartphone android; it is free and can be accessed online anytime and anywhere (Prayitno & Hidayati, 2017; Hursein, 2018; Rizaki, Peniati, & Purwantoyo, 2019).

A research result by Purwaningtyas, et al., (2017) and Ekici (2017) indicated that online-based electronic module using Edmodo could create active learning for students. Students could learn independently and systematically, based on their ability without having a face to face meeting with the teachers. A study conducted by Suwasono (2013) suggested that the result of online e-module

development was valid and feasible to be used in long-distance learning. Solikin (2018) added the result of the development by suggesting that web mobile-based e-module could improve the learning process to be more effective. The web mobile-based e-module can be accessed using students' smartphone. Research by Herawati & Muhtadi (2018) and Utami, et al., (2018), stated that product develops in the form of interactive e-module as valid and interactive. An interactive e-module could be utilized in the classroom as a learning source independently as well as in combination with others. Research by Putranto (2013) showed that online e-module product was valid from content and media aspects. The content was presented with images, and it was following the learning objectives. Hence, it is expected that the developed Edmodo mobile CB e-module could overcome problems occurred in cell biology learning process in higher education. CB is more abstract material. It studies the structure of organelles and the physiological processes contained in the cells as the smallest unit in the living things. The cells can only be observed by using a microscope. Thus, CB is a fundamental concept to support the whole biology course.

METHOD

Type of Research

The study was a research and development (R&D) using Thiagarajan 4D development model consisted of define, design, and develop. Thiagarajan's development model was suitable to develop the product in the form of teaching materials. Besides, the stages in this development model were more detailed and systematic. It aimed to create a product which is relevant and feasible to be used in the learning process, to achieve the learning outcome. Dissemination was done in several stages, namely the expert's validation and feasibility test in small as well as wider scale classroom. Dissemination took a long time while this research was limited to a predetermined time. Thus, dissemination was eliminated in this research.

Research Subject

The research involved 40 students of class 2014 who had completed CB course as a subject in teaching material requirement analysis in define stage and 24 students of class 2016 who currently enrolled in CB course to assess the readability of the developed e-module in small scale test in the developing stage. Those 40 students were used in small scale test to find out the readability of e-module developed. A large-scale trial will be conducted if e-module developed has been valid and feasible to be used in the learning process.

Development Model

Steps in the development of Edmodo mobile CB e-module referred to Thiagarajan 4D development model consisted of four stages, namely: define, design, develop, and disseminate (Thiagarajan, Sivasailam, & Others, 1974). This research was limited up to the development stage due to a time limit; thus, it was unlikely to move to the disseminate stage. The Thiagarajan 4D development model is illustrated in Figure 1.

Development Procedures

Measures taken in the development of Edmodo mobile CB e-module, according to Thiagarajan, can be elaborated as follows.
1. *Define*
   In this stage, several things were performed, namely:
a. Front-end analysis, conducted through observation activities, a document study, an interview to identify initial problems occurred in learning activities.
b. Student analysis, conducted through interview and questionnaire to students related as the user of Edmodo mobile.

c. Assignment and concept analysis, conducted by examining the graduate achievement of CB course in KKNI curriculum in Biology Education, IKIP Budi Utomo Malang.

2. *Design Identification*

The stage aimed to design an Edmodo mobile CB e-module prototype. It consisted of several stages, namely:

a. The formation of a benchmark reference test, conducted by analyzing the graduate achievement of CB course to be used for learning.

b. Media selection, conducted through media alternative selection to cope with problems in front-end analysis and the media chose was Edmodo mobile CB e-module.

c. Format or design selection, conducted by analyzing the form of Edmodo mobile to be developed, including activities in the e-module.
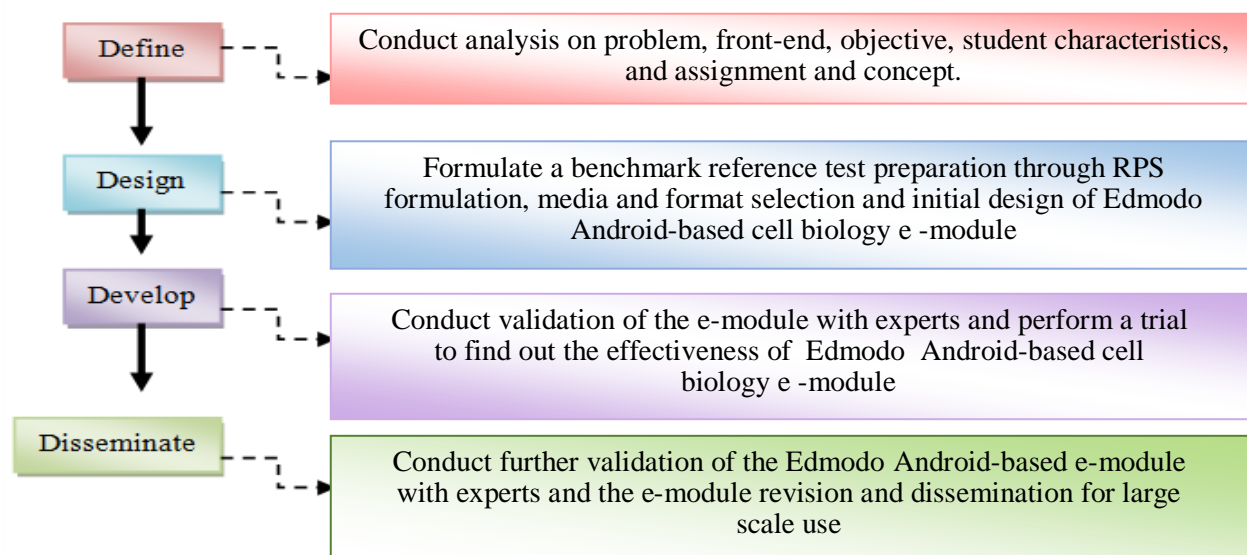

Figure 1. Focus on each stage in thiagarajan 4d development model.

3. *Develop*

The stage aimed to produce Edmodo mobile validated by experts, and some improvement was performed to produce a valid and qualify e-module. The phase consisted of the following activities.

a. Validation

Validation was conducted to obtain the feasibility of the developed Edmodo mobile CB e-module. Validator description that will validate the CB e-module of Edmodo mobile were: 1) content expert validators from competent lecturers in CB field; 2) media expert validators from competent lecturers in learning media and once responsible for learning media course, and 3) practitioners from team lecturer team of CB course IKIP Budi Utomo Malang.

b. Trial

The trial design was done in a small group. The number of the trial was 24 students for a small group test. The trial was performed to investigate whether the developed Edmodo mobile CB e-module was understandable by students as the users or not.

c. Revise

Revise aimed to improve and complete the developed e-module to meet the feasible and effective criteria to be used in learning.

Research Instruments

The research instruments consisted of e-module validation questionnaires by content, education, and media experts as well as students. Following is the description of instruments used:

1. Edmodo mobile CB e-module validation questionnaires by content experts were in the form of assessment questionnaires on the truth/accuracy and appropriateness of cell biology concept.

2. Edmodo mobile CB e-module validation questionnaires by media experts were in the form of assessment questionnaires on writing, image, and writing layout in the e-module.
3. Edmodo mobile CB e-module validation questionnaires by practitioners were utilized to assess the expediency of the e-module in cell biology learning.
4. Assessment surveys from students. The questionnaires consisted of several indicators on the feasibility and readability of the e-module.

Data Analysis Technique

Data obtained from the validation and trial results were qualitative in the form of suggestion information and comments from experts, practitioners, and users of Edmodo mobile CB e-module. Quantitative data, on the other hand, were the scores on the e-module validation questionnaire from experts and users. The questionnaires consisted of a list of problems filled by the respondents as well as assessment questionnaires used by the respondents using Guttman scale, which were a checklist and Likert Scale. Validation questionnaires were analyzed qualitatively and quantitatively. Data used were the score result given in the e-module validation questionnaires. Scores from the e-module validation questionnaires using Likert Scale consisted of four (4) categories of alternative options as follows, 4 (**valid**), 3 (**fairly valid**), 2 (**less valid**), and 1 (**not valid**).

Score data obtained were averaged for each aspect and converted into a percentage using the following formula (Masrur, Corebima, & Ghofur, 2017).

$$P = (\sum X)/(\sum X1) \times 100\%$$

Where:
P = percentage.
$\sum X$ = number of answer from all respondents in one question item.
$\sum X1$ = number of ideal answer in one item
100% = constant.

Table 1 presents validity criteria of validator assessment questionnaire data based on the percentage result of criteria.

Table 1.
Validity criteria of validator assessment questionnaire data.

Score Scale (100%)	Validity Criteria	Description
81-100	Strongly valid	Not Revise
61-80	Valid	Not Revise
41-60	Fairly valid	Revise
21-40	Less valid	Revise
0-20	Strongly not valid	Revise

RESULTS AND DISCUSSION
1. Define Stage

Results obtained in the define stage were problems occurred in CB learning process. The activities were performed using requirement analysis regarding whether e-module teaching material was needed to be developed or not. Some findings in the stage included students response during cell biology lecture, and the experience resulted from previous CB lecturer. Data of student questionnaire results can be seen in Table 2.

Table 2, indicates the following cell biology learning activities: 1) CB learning had not used a clear and interesting learning media as well as information technology (e-learning). 2) CB learning was conducted using lecture. 3) CB learning had not supported by an appropriate learning module. 4) CB learning still used face to face learning and did not use the mobile learning application. 5) CB learning required IT to facilitate CB concept understanding. 6) CB learning required the android app

to facilitate students to understand cell biology content and increase students' learning interest. 7) CB learning had not used a module appropriate to students' requirements. 8) students agreed if CB learning used e-learning. 9) students did not have teaching materials, reading sources, modules in CB learning, and 10) students were not familiar with learning application, such as Edmodo, that can be opened with their smartphone.

Table 2.
Questionnaire data by students on cell biology course learning activities.

No	Indicator	Percentage (%)
1.	CB learning process you'd ever received used interesting media.	47,78
2.	CB learning should be conducted using clear and interesting visual media.	82,22
3.	CB learning was conducted through lecture.	46,11
4.	CB learning should be conducted by utilizing information technology (e-learning).	87,78
5.	CB learning should be supported by appropriate module or teaching material.	56,67
6.	CB learning should be applicable outside the classroom using e-learning application or mobile learning.	86,11
7.	CB learning using IT could raise our interest to learn cell biology concept.	88,33
8.	The use of media in the form of android application-integrated module or textbooks could facilitate students to understand the content.	88,89
9.	The use of the android application in learning could increase curiosity and attract students interested in learning.	80,56
10.	Learning using visual media could facilitate an abstract concept learning on CB.	90,56
11.	CB learning used an interesting learning model.	33,33
12.	CB learning utilized appropriate modules or teaching materials.	35,56
13.	CB learning applied an interesting media.	40,00
14.	CB learning was boring.	62,22
15.	Do you agree if CB learning is conducted using e-learning.	73,33
16.	Have you ever performed CB learning activity using e-learning.	20,00
17.	Have you ever had a teaching material or module to support CB learning activities.	20,00
18.	Have you ever used Edmodo android application in learning.	0,00

Based on the above description, an innovative learning strategy was a necessity to improve the CB learning process quality. For example, Edmodo mobile has to develop for students. It is in line with a statement from Pratiwi, Hidayah, & Martiana (2013) and Djamahar, et al., (2019) that to improve learning quality in higher education institutions, one of the ways is by teaching material development strategy, such as learning module. More innovative new strategies using information technology are vital to support proper learning implementation. Learning supported by a teaching material such as e-module and learning application could create a more meaningful and challenging learning process. The statement is by a statement from Herawati & Muhtadi (2018) and Rosamsi, et al., (2019) that the presence of changes and learning (paradigm) thinking shift will provide a huge impact on various learning aspects, especially in the development of information technology-integrated teaching materials and media exist. The use of a module appropriate to students requirements (characteristics and environment) provides new strength for them to understand the learning subject easily. Pratiwi et al., (2013), also stated that teaching material, such as module, should be compiled by students' characteristics and environment; hence, the developed teaching material influences facilitating students to understand the learning contents. Smartphone use in learning will assist students in accessing learning content in the module. A flexible e-module will make students learn comfortably. It is also in line with Amalia, Wuryanto, & Sukestiyarno (2016) that the developed module should stand alone, adaptive, and user-friendly. The module can be accessed by students individually as well as together with other students. The module should be

adaptive, meaning that it should keep up with the development in science and technology, and it should also be flexible. A user-friendly module indicates that it should have characters that match the users. Therefore, due to the problems found in CB learning, as stated above, a module with the design that could give a solution to the issues is required.

2. Design Stage

Based on the analysis result in the define stage, the appropriate teaching material set was e-module. E-module was developed to stimulate critical thinking culture and students' conceptual understanding. The e-module content design is illustrated in Figure 2.
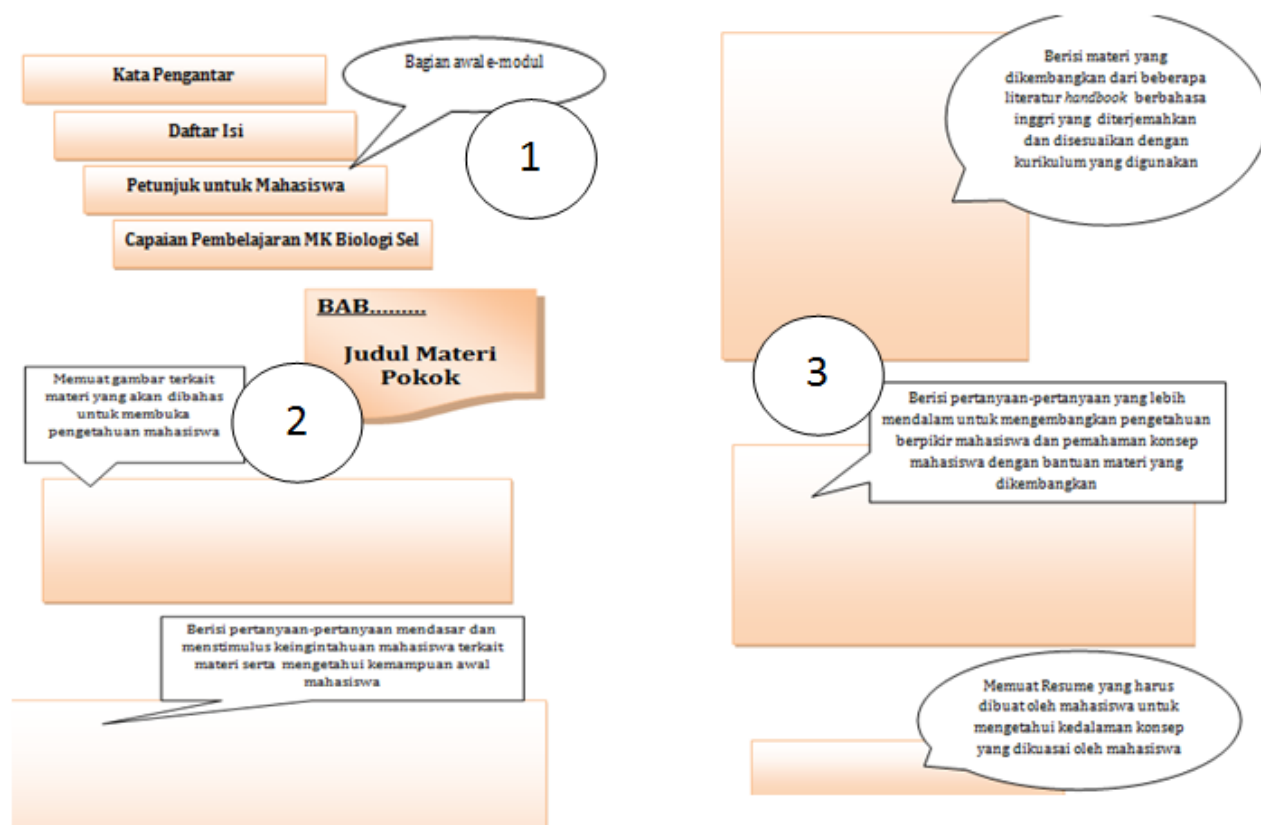

Figure 2. Content design of edmodo android-based cell biology e-module.

The design of Edmodo mobile CB e-module as illustrated in Figure 2 was capable of playing a role as an information source of cell biology content according to students' requirement and science and technology development as well as facilitating students' critical thinking ability. It is in line with Purwaningtyas, et al., (2017) and Suryanda, et al., (2016)., that a current module is a module that could be integrated with technology development. Regarding e-module using free learning application, such as Edmodo, Fitriyati, Mufti, & Lestari (2015), Suryanda, et al., (2016) and Hidayat, et al., (2019) added that the utilization of e-module in learning was able to transform direct learning to a more planned learning and students were able to learn anytime and anywhere without lecturer direction. E-module could assist lecturers in training students' initiative, independence, and self-confidence in learning (Purwaningtyas, et al., 2017; Ekici, 2017; Isfaeni, et al., 2018; Toy et al., 2018; Supriyatin & Ichsan, 2018).

3. Develop Stage

Results obtained in the development stage was the result of experts' validation consisted of content experts, media experts, and practitioners. The result by experts can be seen in Table 3.

Table 3a.
General assessment result by content experts.

No	Indicator	Validity Score (%)	Criteria
1.	**Content completeness**		
	The scope of main content included competencies.	100	Strongly Valid
	There was no content repetition.	100	Strongly Valid
2.	**Content accuracy**	100	Strongly Valid
	Concept of righteousness.	100	Strongly Valid
	Contextual application in the real world.	100	Strongly Valid
3.	**Content presentation**		
	Content arrangement according to competenciessequence.	100	Strongly Valid
	Content presented was mutually related.	100	Strongly Valid
	The content was arranged systematically.	100	Strongly Valid

Table 3b.
Detail assessment result of content experts.

Assessed Indicator	Validity Score (%)	Criteria
Chapter I. Prokaryotic and eukaryotic cells		
1. Cell Definition.	100	Strongly Valid
2. Division of prokaryotic and eukaryotic cells.	100	Strongly valid
3. Prokaryotic definition.	75	valid
4. Parts of prokaryotic.	75	Valid
5. Eukaryotic definition.	75	Valid
6. Classification of eukaryotic.	75	Valid
7. Parts of animal cells.	100	Strongly Valid
8. Parts of plant cells.	100	Strongly Valid
Chapter 2. Cell membrane		
1. Cell membrane definition	100	Strongly Valid
2. Cell membrane structure	100	Strongly Valid
3. Cell membrane function	100	Strongly Valid
4. Membrane transport mechanism	100	Strongly Valid
5. Passive transport characteristics	100	Strongly Valid
6. Membrane permeability properties	100	Strongly Valid
Chapter 3 Cytoskeleton		
1. Cytoskeleton structure	100	Strongly Valid
2. Microtubules structure	100	Strongly Valid
3. Microfilaments structure	100	Strongly Valid
4. Intermediate filaments structure	100	Strongly Valid
5. Cytoskeleton roles	100	Strongly Valid
Chapter 4 Nucleus		
1. Nucleus structure	100	Strongly Valid
2. Mechanism of substance secretion from and to the nucleus	100	Strongly Valid
3. Types of substance that could enter and exit the nucleus	100	Strongly Valid
4. Nucleus functions	100	Strongly Valid

Based on Table 3a and Table 3b, it can be seen that the developed Edmodo mobile CB e-module met the valid and strongly valid criteria; thus, it can be stated that it was feasible to be used in learning. Content concept of righteousness in the e-module required significant attention. Mistakes in

elaborating CB concept in the e-module could have an impact on students failure in learning. It is in line with a research result by Bahri, Syamsuri, & Mahanal (2016) that the most important thing related to content put in the module was content accuracy and righteousness. Failure in meeting the criteria could create a new problem and plunge the readers, especially students. Further, cell biology e-module would be an essential learning source to improve students' abilities. It is following Andrinata, Sumarmi, & Astina (2016), Purwaningtyas, et al., (2017), Ekici, (2017), and Isfaeni, et al., (2018) that e-module is necessary for students since it plays a role as a learning source that could support improvement in students' ability to learn. Validation result of media expert is presented in Table 4.

Table 4.
Assessment Result of Media Experts

Assessed Indicator	Validity Score (%)	Validity Criteria
A. E-module Size		
1. The suitability of e-module size.	100	Strongly Valid
2. The suitability of size to content.	100	Strongly Valid
B. E-module Cover Design		
1. The display of cover layout element.	100	Strongly Valid
2. E-module cover design.	75	Valid
3. Composition and size of the cover layout element.	75	Valid
4. The color of the e-module cover layout element.	100	Strongly Valid
C. E-module Cover Typography		
1. Cover's letters size was more dominant and proportional.	100	Strongly Valid
2. The color of the e-module title was in contrast to the background.	100	Strongly Valid
D. E-module cover illustration		
1. Cover illustration described the content.	100	Strongly Valid
E. E-Module Content Design		
1. Clear separation between the paragraphs.	100	Strongly Valid
2. Appropriate space between text and illustration.	100	Strongly Valid
3. A clear title of chapters, sub-chapters, and pages.	100	Strongly Valid
4. Illustration and image legend.	75	Valid
5. Good position of title, sub-title, and description.	100	Strongly Valid
F. E-module content typography		
1. Did not use many types of letter.	100	Strongly Valid
G. E-module illustration		
1. It can send the meaning.	100	Strongly Valid
2. Accurate and proportional form.	75	Valid
3. Creative and dynamics.	100	Strongly Valid
H. Language Feasibility		
1. Language comprehension used.	75	Valid
2. Accuracy grammar and spelling.	75	Valid
3. The rigidity of the terms.	75	Valid
4. The integrity of meaning in chapters, sub-chapters, and paragraphs.	100	Strongly Valid
I. Presentation completeness		
1. Preface.	75	Valid
2. Table of contents.	100	Strongly Valid
3. Body (consisted of chapters).	100	Strongly Valid
4. References.	100	Strongly Valid

Table 4 indicates that the developed e-module had size, cover design, typography, cover illustration, content design, content typography, illustration, language feasibility, and presentation completeness that were stated as feasible. E-module display should be interesting and not

monotonous; thus, students as readers felt happy and did not feel bored when reading it. The result is by research by Bahri et al., (2016), that a good e-module has a proportional cover display, content text, and images; thus it is easy to read by students. Some suggestions from media experts were related to typos, words consistency, the placement of some less proportional images, and other minor mistakes. Validation results of practitioners can be seen in Table 5.

Table 5.

Assessment result of practitioners.

No	Indicator	Validity Score (%)	Criteria
1.	Instruction for use for lecturer.		
	Easiness to understand the instruction for use.	100	Strongly Valid
2.	Direction for use for students.		
	Easiness to understand the instruction for use.	100	Strongly Valid
3.	Content completeness.		
	The main content scope was by RPS content.	100	Strongly Valid
	The main content scope consisted of essential competencies.	75	Valid
4.	Content.		
	Constructed students knowledge on content learned.	75	Valid
	The accuracy of learning content sequence.	100	Strongly Valid
	Helped students to master the concept.	100	Strongly Valid
5.	Types of Student Activities.		
	Accuracy of students activities with the content.	100	Strongly Valid
	Motivated and created learning interest.	100	Strongly Valid
6.	Evaluation Test.		
	Accuracy of questions with the content.	100	Strongly Valid
	Feasibility of questions as measuring instrument.	100	Strongly Valid
	Number of questions presented.	100	Strongly Valid
7.	Answer Keys.		
	Accuracy of answer keys with the questions.	100	Strongly Valid
	Easiness to understand the answer keys.	100	Strongly Valid
8.	The appropriateness to learners' level.		
	The appropriateness to the thinking ability level.	75	Valid

According to the assessment results of practitioners in Table 5, it indicates that Edmodo mobile CB e-module was valid. The e-module had the following characteristics: 1) it was equipped with instruction for use for lecturer as well as students; 2) the content was in accordance with RPS and essential competencies to be achieved; 3) it was equipped with students' independent activities; (4) it was equipped with evaluation test and answer keys; and 5) the e-module was developed in accordance with students' thinking ability level. The result is in line with Pratiwi et al., (2013), Prayitno & Hidayati, (2017), Hursein, (2018), and Hidayat, et al., (2019) stated that module preparation must be by learning achievement and competencies to be achieved in RPS. The module should include instruction for use, content description, student activities as well as evaluation test and answer keys. Marzuqi & Sihkabuden (2016), Herawati & Muhtadi (2018) and Utami, et al., (2018), added that based on their research, module should contain cover, preface, table of content, instruction for use for lecturer and students, learning competence illustration and learning objectives, the content must be equipped with images as well as evaluation test and answer keys to find out students' understanding of the material in the module. Results of the readability test of the Edmodo mobile CB e-module by students is presented in Table 6.

Table 6.
Readability assessment result by students.

No	Indicator	Validity Score (%)	Criteria
1.	E-module identity was clear.	95,00	Strongly Valid
2.	The language used in the e-module was clear.	90,00	Strongly Valid
3.	Instruction for the use of evaluation question was easy to understand.	83,75	Strongly Valid
4.	The language used in the e-module evaluation was easy.	86,25	Strongly Valid
5.	E-module could create motivation.	86,25	Strongly Valid
6.	E-module could create independence.	87,50	Strongly Valid
7.	E-module could improve critical thinking ability.	81,25	Strongly Valid
8.	E-module content was relevant to the CB learning.	91,25	Strongly Valid
9.	E-module content was completed and comprehensive.	90,00	Strongly Valid
10.	E-module learning could improve learning motivation.	82,50	Strongly Valid
11.	E-module learning could facilitate CB content learning.	83,75	Strongly Valid
12.	The utilization of e-module could help to master the concept.	83,75	Strongly Valid
13.	Images in the e-module were clear and could facilitate conceptual understanding.	80,00	Strongly Valid

Based on Table 6, the Edmodo mobile CB e-module had stated as valid. The e-module confirm the following characteristics: 1) clear identity, 2) the language was easy to understand, 3) able to create students' motivation and independence, 4) create students' critical thinking, 5) content was relevant to specified competencies and easy to understand, and 6) images in the e-module facilitated students to understand the CB concept clearly. Further, students must complete the content in Chapter I before continued to Chapter II and so on. It is in line with a research result by Amalia et al.,(2016), Bahri et al., (2016), Pratiwi et al., (2013), and Prayitno & Hidayati, (2017) that a suitable module should contain an easy to understand and communicative language, it has clear objectives and feedback against students appraisal; thus students could identify their level of understanding of the content presented.

The developed module was presented electronically, known as e-module (Suryanda, et al., 2016; Howard, & Miskowski, 2005, Hidayat, et al., 2019). The e-module was provided as a supporting teaching material of cell biology course. The availability of Wi-Fi facility in learning encouraged the researchers to innovate by developing an e-module. When there was a problem with the Wi-Fi connection, the students can use their own internet data connection. The developed e-module could be accessed anywhere and anytime with no limitation in space as well as time. The e-module developed by the researchers was integrated with Edmodo, which is a safe and responsible virtual learning facility. The e-module development and implementation aimed to motivate students learning, train students to learn independently and responsibly according to their abilities, facilitate lecturers to measure learners' learning outcome, and to help learners to achieve essential competencies of cell biology course specified in the curriculum. They are excited to interact with each other by an online platform like using social media. It is in line with Herawati & Muhtadi (2018) and Putranto (2013) that e-module utilization integrated with learning software could give great opportunities for students to access the module. Students could use the e-module independently or with other students in the classroom.

The research results can be compared to previous researches such as Purwaningtyas et al., (2017), Putranto (2013), Herawati & Muhtadi (2018), Suwasono (2013), and Solikin (2018), that generally explained the validation results of experts (content experts, media experts, and practitioners) and readability test to users against the development product in form of e-module. The validation result of the research development product indicated that the e-module was valid although there were differences in terms of the type of development model used, the e-module developed and result of readability test to users in the research. The readability test results in the development of Edmodo mobile CB e-module indicated average score validity of 86.25%. The score was gotten from

validation mean score of experts (media expert, material expert, and practitioner). It showed that the readability test result of the e-module was lower than the readability test in previous research.

CONCLUSION

CB e-module of Edmodo mobile was considered valid. Hence, this e-module could be used in CB learning on a higher education level, although it has a similar display like other e-modules. This CB e-module contains the following aspects: 1) Use-instruction for lecturer and students. 2) content was following the lesson plan of the semester, and essential competencies to be achieved and had high accuracy. 3) it was equipped with images that helped to improve students' understanding of the CB concept. 4) it was equipped with students independent activities. 5) it was equipped with an evaluation test and key answers. 6) the developed e-module was by students thinking ability.

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