Development of circulatory system mobile learning (CSML) for grade XI students

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ARTICLE INFO	ABSTRACT
	The utilization of communication devices such as mobile phones as a learning support tool in the development of technology 4.0 is still low. The low mobile phone utilization as a learning support tool causes the variety of learning media used by teachers to be low. The low variety of learning media results in students having difficulty mastering the concept of learning material, especially circulatory system material in class XI. The difficulty of concept mastery on circulatory system material can be overcome through the development of circulatory system mobile learning (CSML). The research objectives are: 1) Develop CSML on circulatory system material in grade XI, 2) Test the feasibility of CSML, and 3) Know the response of teachers and students to CSML. The type of research is Research and Development (R&D) using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data collection uses feasibility validation questionnaires and response questionnaires. The data analyzed were the results of the feasibility assessment from media experts and material experts, and the results of responses from teachers and students. Data analysis was carried out quantitatively descriptive using a Likert scale of 1-4. The results of the study are 1) The result of developing CSML can be accessed online; 2) The results of the feasibility assessment from media experts were 82.27% and material experts were 89.59% with a very feasible category; 3) The results of teacher responses were 87.02% and student responses were 88.55% with a great category.

INTRODUCTION

Technological progress 4.0 as something that cannot be avoided and occurs following the development of science (Ngafifi, 2014). One of the technological developments in the era of technological progress 4.0 is shown by the development of increasingly sophisticated communication devices, one of which is a cellphone (Danuri, 2019). The development of increasingly sophisticated cell phones can be utilized as a learning support tool, but the utilization of cell phones as a tool to support learning activities is still low (Anggraeni & Sole, 2018). The low utilization of cell phones as a supporting activity for learning activities is also known from a needs analysis conducted on 69 Class XI students at five high schools in the Greater Solo area.

The results of a needs analysis conducted on 69 grade XI students at 5 high schools in the Greater Solo area show that the utilization of communication devices such as cell phones as a learning support tool in the era of technological advances 4.0 is still low, most of students use cell phones to access social media up to 8 hours/day. The need analysis result relevant to the previous research, most high school students use their mobile phones dominantly to access social media (Instagram), so the use of cell phones as a tool to support learning activities is still low (Rahayuwati et al., 2019).

The utilization of mobile phones as a tool to support learning activities in the era of technological progress 4.0 which is still low can be improved through the development of digital learning media (Fatimah & Mufti, 2014; Anggraeni & Sole, 2018). The recommended digital learning media in the era of technological advances 4.0 is game-based mobile learning that can be accessed through communication devices such as cell phones (Sarhandi et al., 2017; Cameron & Bizo, 2019; Ardiansyah & Nana, 2020; Purwanto & Mentara, 2023).

The advantages of using game-based mobile learning as a learning media are that it increases the flexibility of time and place because learning materials can be accessed through cell phones (Fatimah & Mufti, 2014; Sarhandi et al., 2017; Cameron & Bizo, 2019; Samsinar, 2020), improves students' ability to think quickly on decision making, improves foreign language skills, reduces stress, train patience, train dexterity (Sandy & Hidayat, 2019), and increase motivation in learning (Alsawaier, 2015). The advantages of game-based mobile learning as a learning media can help students master the concept of material in biology subjects, including circulatory system material (Rohwati, 2012; Ipin, 2018; Thaariq & Yanda, 2018).

Game-based mobile learning needs to be used on circulatory system material because the use of lecture methods without the help of learning media results in students having difficulty mastering concepts (Thaariq & Yanda, 2018). The difficulty of mastering the concept of circulatory system material is caused by material that is abstract, complex, and not contextual, thus requiring students to think highly to imagine the circulatory process that occurs (Rohmawati, 2011; Sukenti, 2021; Safitri et al., 2021). The results of the needs analysis also show that the difficulty in mastering concepts experienced by students in learning biology is highest in the material of the circulatory system, particularly explaining and analyzing the relationship between functions between organs in the circulatory system.

According to the need analysis result, the difficulty of mastering the concept of circulatory system material for grade XI students at 5 high schools in the Greater of Solo area is not only caused by the difficulty of the material, but also by the low variety of learning media used by teachers. The teachers usually used PowerPoint as a learning media on circulatory system material, while a few of them used torsos, posters, and YouTube videos. The low variety of learning media based on the need analysis result is relevant to the previous research (Rahayuwati et al., 2019; Safitri et al., 2021). The low variety of learning media on circulatory system material can be improved through the development of digital learning media, such as game-based mobile learning (Sukenti, 2021; Safitri et al., 2021).

Students assess the use of more varied learning media such as game-based mobile learning can make circulatory system material more interesting and contextual, making it easier for students to master the concept of circulatory system material. Thus, it is necessary to develop game-based mobile learning media on circulatory system material in class XI. The research conducted aims to develop Circulatory System Mobile Learning (CSML) on circulatory system material for grade XI students.

METHODS

Research Design

The research was conducted in one of the senior high schools at Surakarta, in June - November 2022. The type of research conducted is Research and Development (R&D) research using the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation) in the development of CSML learning media (Branch & Kopcha, 2014; Cahyadi, 2019; Aydin et al., 2023; Cahyaningsih & Supartinah, 2023; Tsai & Chou, 2023). The ADDIE model was used in the development of CSML because it is considered to have stages that are easy to implement, flexible, systematic according to the needs and characteristics of students, and logical by using the output at each stage as input to the next stage (Tegeh & Kirna, 2013; Cahyadi, 2019; Aydin et al., 2023; Tsai & Chou, 2023). Details of ADDIE model (Analyze, Design, Development, Implementation, and Evaluation) are explained below.

1) Analyze

Analyze is done to identify student needs, students' initial abilities, and learning objectives to be achieved, and student characteristics (Brown & Green, 2015; Aydin et al., 2023; Cahyaningsih & Supartinah, 2023). The analysis carried out is student needs analysis, task analysis, and learner analysis (Aydin et al., 2023; Cahyaningsih & Supartinah, 2023).

Needs analysis is carried out to find out the real conditions that occur in learning such as problems and conditions expected by students, so that the expected changes can be realized (Brown & Green, 2015). The needs analysis was conducted on 69 grade XI students consisting of SMA Negeri 1 Surakarta, SMA Negeri 1 Sragen, SMAIT Nur Hidayah Surakarta, SMA Muhammadiyah 1 Sragen, and SMA N 2 Boyolali. Data collection on student needs analysis was carried out using a questionnaire.

Task analysis is conducted after analyzing student needs. The purpose of the task analysis is to determine the scope of the material, the order of the content, and the assignments that need to be compiled (Brown, A. H., & Green, 2015). The output of the task analysis stage is the determination of learning objectives that students must achieve in learning activities.

Learner analysis is carried out to determine the characteristics of learners which include student perceptions of circulatory system material, demographic conditions, and psychological conditions of learners who are the subject of research. Information related to learners is collected with the aim of being able to produce effective and efficient instructions or learning media to be applied to students (Branch & Kopcha, 2014; Brown, A. H., & Green, 2015).

2) Design

Design is done to create a CSML prototype (Tsai & Chou, 2023). The design stage is the planning stage for making CSML which consists of content design activities, product design, trial strategy design, and research instrument design.

3) Development

Development is the stage of realizing CSML prototypes which includes activities to create, modify, and revise CSML (Cahyadi, 2019; Aydin et al., 2023). The development stage consists of making CMSL using Articulate Storyline 3 software installed on a laptop, conducting feasibility validation by media experts and material experts, and implementing revisions to fix CSML deficiencies (Branch & Kopcha, 2014).

4) Implementation

Implementation is the stage of using CSML for students and teachers in learning (Cahyaningsih & Supartinah, 2023). The implementation stage is carried out by testing CSML which has been validated and revised according to the input of media experts and material experts on a limited scale to student biology teachers (Branch & Kopcha, 2014). The purpose of implementation is to determine the response of teachers and students to CSML.

5) Evaluation

Evaluation is the stage of revising CSML deficiencies based on the results of the validation of the feasibility of media experts and material experts, as well as the results of teacher and student responses (Cahyadi, 2019).

Population and Samples

The population consisted of 224 students from all class XI MIPA at one of the Public Senior High Schools in Surakarta, meanwhile the sample was 65 students from two classes in grade XI MIPA. The sample was chosen by using purposive sampling type (Sugiyono, 2013; Cahyani et al., 2021). Purposive

sampling conduct based on the certain considerations (Sugiyono, 2013; Cahyani et al., 2021), those are grade level, major, availability of laptop or cellphone communication devices, and equality of student cognitive abilities.

Instrument

Data collection instruments on needs analysis, task analysis, learner analysis, CSML feasibility assessment from media experts and material experts, and responses from students and teachers were carried out using questionnaires. Questionnaires are a form of data collection instrument that is relatively easy, flexible to use (Pramita, 2015), and easy to collect large amounts of data (Ismail & AlBahri, 2019; Pranatawijaya et al., 2019). The questionnaire contains several written questions that are structured to obtain information from respondents regarding the research variables being measured (Muchlis et al., 2019; Pranatawijaya et al., 2019). Data collection instruments in CSML manufacturing research are presented in Table 1.

Table 1.
Data Collection Instruments

Stage	Procedure	Instrument	Subject
Analyze	Needs analysis	Questionnaire	Students
	Task analysis	Questionnaire	Students
	Learner analysis	Questionnaire	Students
Development	Feasibility validation	Questionnaire	Media experts and material experts
Implementation	Testing	Questionnaire	Students and teachers

Procedure

CSML learning media developed using the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation) (Branch 2009; Cahyadi, 2019; Aydin et al., 2023; Cahyaningsih & Supartinah, 2023; Tsai & Chou, 2023). The test was validated by expert judgment consisting of 2 media experts and 2 material experts, then tested on 2 biology teachers and 65 students from grade XI.

Data Analysis Techniques

Analysis of the results of the feasibility assessment from media experts and material experts as well as the results of teacher and student responses was carried out descriptively quantitatively using a Likert scale of 1-4 to measure the perceptions, attitudes, or opinions of a person or group related to a social event or phenomenon (Bahrun et al., 2017; Pratiwi et al., 2017). The Likert scale of 1-4 serves to provide opportunities for respondents to provide opinions in the form of approval of the questions asked (Pramita, 2015). The Likert scale 1-4 are represented some of the scoring categories, those are scale 1 (strongly agree), scale 2 (agree), scale 3 (disagree), and scale 4 (strongly disagree) (Antika & Suprianto, 2016; Youn et al., 2017).

The total number of scoring categories using Likert 1-4 was then calculated with the following formula, to determine the percentage of media feasibility from media experts and material experts as well as responses from teachers and students. The feasibility percentage is obtained using the formula for the number of scores obtained divided by the maximum score and then multiplied by one hundred percent (Accraf et al., 2019). The results of the percentage calculation of media experts' and material experts' feasibility are interpreted into some of percentage criteria in descriptive sentences, those are very feasible (82% - 100%), worth (63% - 81%), not worth it (44% - 62%), and very unfeasible (25% - 43%) (Widoyoko, 2012; Antika & Suprianto, 2016).

Meanwhile, the results of the percentage calculation of teacher's and student's responses are interpreted into some of percentage criteria in descriptive sentences, those are very good (82% - 100%), good (63% - 81%), not good (44% - 62%), not very good (25% - 43%) (Widoyoko, 2012; Antika & Suprianto, 2016).

RESULTS AND DISCUSSION

The results and discussion for Circulatory System Mobile Learning (CSML) include CSML development, feasibility validation from media experts and material experts, and teacher and student responses.

1. Development of Circulatory System Mobile Learning (CSML)

Circulatory System Mobile Learning (CSML) was developed using the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation) (Branch & Kopcha, 2014). The developed CSML can be accessed online through a laptop, smartphone, or tablet communication device. The CSML display consists of a starting page, home page, competency page, material page, and evaluation game page on class XI circulatory system material. The CSML home page is the first page seen when accessing CSML. The CSML home page view is presented in Figure 1.

Figure 1. CSML Home page

The home page features a competency menu, material menu, evaluation game menu, and illustrative video of the circulation system. The competency page features a basic competency menu, indicator menu, learning objectives menu, and material preparation reference menu. The main page display (HomePage) is presented in Figure 2.
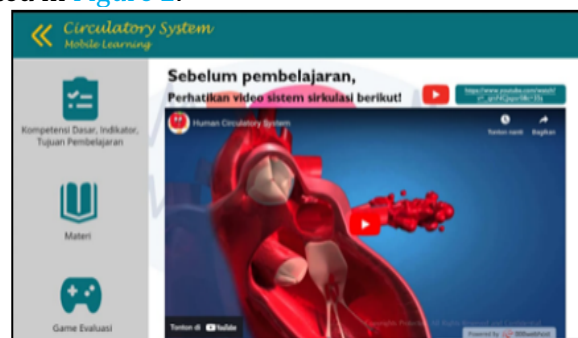

Figure 2. Home Page Display

The material page displays a selection of circulatory system sub-materials. The material is organized per sub-chapter to make it easier for students to learn the material concisely and simply per sub-chapter of circulatory system material. The main subchapters in the circulatory system material are blood, heart, blood vessels, and abnormalities in the circulatory system.

The evaluation game page displays a menu of practice questions about mastering the concept of circulatory system material. The purpose of making an evaluation game is to create an interesting and fun atmosphere for learning the material and working on questions. Evaluation games are arranged with levels of difficulty in stages. The display of the Evaluation Game Page is presented in Figure 3.
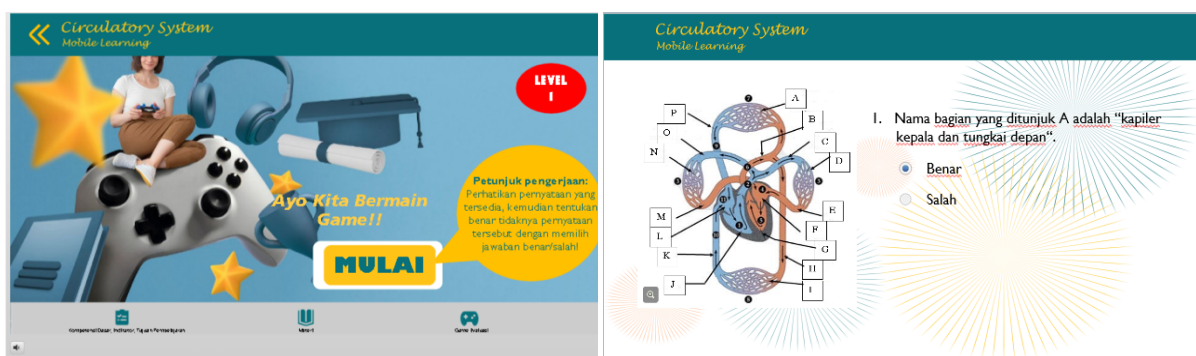

Figure 3. Evaluation Game Page Display

2. Circulatory System Mobile Learning (CSML) Feasibility Validation

CSML is validated for feasibility by media experts and material experts. The results of feasibility validation from media experts and material experts are described as follows.

1) Media Expert Validation

Media validation was conducted by 2 media experts. Media validation was conducted to measure feasibility in 4 aspects: 1) appearance and design aspects, 2) language aspects, 3) usability aspects, and 4) compatibility aspects. The results of media validation are presented in Table 2.

Table 2.
Media Expert Validation Results

Validation Aspect	Average of Feasibility (%)	Category
Display and Design	85.33	Very Feasible
Language	87.50	Very Feasible
Usability	81.25	Worth
Compatibility	75.00	Worth
Average (%)	**82.27**	**Very Feasible**

Table 2 shows the results of media validation from Media Expert I and Media Expert II. The average percentage of CSML feasibility validation from media experts is 82.27% with a very feasible category. CSML feasibility validation from media experts includes 4 aspects, namely appearance and design aspects (85.33%), language aspects (87.50%), usability aspects (81.25%), and compatibility aspects (75%). The feasibility of the appearance and design aspects is measured from 6 indicators which include: 1) the quality of the presentation of images or illustrations; 2) the quality of the presentation of videos; 3) the readability of fonts in the text; 4) the proportionality of the placement of text, images, and videos; 5) the attractiveness of the application page design for users; and 6) the representativeness of the menu icon design to clarify the function of application features. The feasibility of the language aspect is measured from several indicators which include: 1) suitability of language use with Indonesian language rules; 2) suitability of language with the development level of grade XI students; and 3) communicativeness of language use. The feasibility of usability aspects is measured from 2 indicators, namely the ease of using the application for users (users) and the functionality of menu buttons on features. The feasibility of the compatibility aspect is measured from the CSML compatibility indicator on the user's communication device. CSML is considered feasible when viewed from the media aspect because it has fulfilled the principles of making a good learning game (Sandy & Hidayat, 2019), namely active feedback, active learning, motivation, social, scaffolding, and transfer.

The application of the active feedback principle in CSML is indicated by the "*Scoring and Review Quiz*" feature on the evaluation game menu. The "Scoring and Review Quiz" feature is given to provide direct responses or feedback after working on evaluation questions so that students can find and correct mistakes in understanding the circulatory system material. The application of the active principle in CSML is indicated by the operation of features that actively involve students. The application of the motivation principle in CSML is shown by the evaluation game feature, which has a level of difficulty. Students who complete the challenge of working on evaluation questions at the first level will be rewarded in the form of scores and game upgrades to the next level. Rewards are given to increase student motivation in learning (Sandy & Hidayat, 2019). The application of social principles in CSML is indicated by the opportunity for students to ask each other and compare the acquisition of evaluation game scores so that social interaction between students can be built. The application of the scaffolding principle is carried out by challenging evaluation questions with graded difficulty at level 1, level 2, and level 3. Game learning needs to be designed in a multi-level manner so that students become experts at each level and cannot proceed to a higher level before completing the challenges at the previous level. (Sandy & Hidayat, 2019). The application of the transfer principle in CSML is carried out by providing opportunities for students to exchange information or knowledge through group assignment activities.

The average percentage result of CSML feasibility validation from media experts of 82.27% with a very feasible category is also in accordance with the results of the analysis of several previous studies. Similar previous studies such as android-based mobile learning on the material of the body's defense system obtained feasibility validation from media experts of 96% with a very feasible category (Gagese

et al., 2018). Adaptive mobile learning (A-MoL) on general biology learning obtained feasibility validation from media experts of 3.53 with a very feasible category according to the categorization reference used by Mardapi (2008) (Surahman, E., & Surjono, 2017). The validation of the feasibility of A-MoL by media experts was assessed from 5 aspects, namely 1) aspects of ease of operation, 2) aspects of ease of navigation, 3) aspects of adaptive ability to user learning styles, 4) aspects of display quality, and 5) aspects of general illustration quality (Surahman, E., & Surjono, 2017). Mobile learning based on e-books on plant structure material obtained feasibility validation from media experts of 100% with a very feasible category (Budi Utomo et al., 2018). Mobile learning based on android applications on nervous system material obtained feasibility validation from media experts of 100% with a very feasible category (Arsiyanti & Widodo, 2018). Based on the results of the feasibility analysis of media aspects on similar learning media, CSML is considered very feasible to be used as a learning media for the circulatory system of class XI.

The advantages of CSML from similar learning media make CSML considered feasible to use as a learning media for class XI circulatory system material. The advantages of CSML in the media aspect are: 1) from the aspect of compatibility, CSML can be accessed using all types of communication devices online anytime and anywhere without time and space restrictions; 3) from the aspect of usability, CSML is easy to use without having to practice because the CSML menu display is presented simply with representative icons; 4) from the aspect of language, the presentation of circulatory system material on CSML is carried out per sub-chapter using detailed but concise and simple language; 5) from the aspect of appearance and design, the presentation of material on CSML is equipped with illustrations, images, tables, graphs, and representative videos that make it easier for students to learn the material.

2) Material Expert Validation

Material validation was carried out by 2 material experts. Material feasibility validation was carried out to measure the feasibility of 2 aspects consisting of aspects of content feasibility and aspects of material content presentation. The measurement of the feasibility of the 4 aspects was carried out using a questionnaire with a Likert scale of 1-4 which was equipped with a grid, assessment indicators, and an assessment rubric. The results of material validation are presented in Table 3.

Table 3.
Material Expert Validation Results

Validation Aspect	Average OF Feasibility (%)	Category
Content Feasibility	91.67	Very Feasible
Presentation of Material Content	87.50	Very Feasible
Average Percentage of Overall Feasibility (%)	**89.59**	**Very Feasible**

Table 3 shows the results of material validation from material expert I and material expert II. The average percentage of CSML feasibility validation from material experts is 89.59% with a very feasible category. CSML feasibility validation from material experts includes 2 aspects, namely aspects of content feasibility (91.67%) and aspects of material content presentation (87.50%).

The feasibility of the content feasibility aspect is measured from 3 indicators: 1) the truth and accuracy of the material concept; 2) the novelty of the material; and 3) the completeness of the content. The feasibility of the presentation aspect of the material content is measured from 5 indicators which include: 1) systematic presentation of the material; 2) relevance of the presentation of examples to the material; 3) representativeness of images or illustrations presented to clarify concepts; 4) representativeness of videos presented to clarify concepts; and 5) accuracy of the use of biological terms in the content.

CSML is considered feasible when viewed from the material aspect because it has fulfilled the principles of making a good learning game according to Sandy & Hidayat (2019), namely individualization and assessment. The application of the principle of individualization in CSML is indicated by the presentation of circulatory system material in accordance with the needs of students. Circulation system material on CSML is designed according to the results of needs analysis, task analysis, and analysis of grade XI students. The application of the assessment principle in CSML is indicated by the existence of an evaluation game feature in the form of practice questions. The evaluation game

feature is equipped with a scoring feature that can display the score of the results of working on evaluation questions. According to Sandy & Hidayat (2019), game learning must provide an opportunity for each individual to be able to assess themselves or compare them with others. The purpose of assessment is to evaluate student performance and learning outcomes.

The average percentage result of CSML feasibility validation from material experts of 89.59% with a very feasible category is also in accordance with the results of the analysis of several previous studies. Similar previous studies such as android-based mobile learning on the material of the body's defense system obtained feasibility validation from material experts of 85% with a very feasible category (Gagese et al., 2018). Adaptive mobile learning (A-MoL) on general biology learning obtained feasibility validation from material experts of 3.62 with a very feasible category according to the categorization reference used by Mardapi (2008) (Surahman, E., & Surjono, 2017). Validation of the feasibility of A-MoL by material experts was assessed from 4 aspects, namely aspects of learning, aspects of content correctness, aspects of completeness, accuracy and meaningfulness of the material, and aspects of the language of the material presented (Surahman, E., & Surjono, 2017). Mobile learning based on e-books on plant structure material obtained feasibility validation from material experts of 87% with a very feasible category (Budi Utomo et al., 2018). Mobile learning based on android applications on nervous system material obtained feasibility validation from material experts of 100% with a very feasible category (Arsiyanti & Widodo, 2018). Based on the results of the feasibility analysis of material aspects on similar learning media, CSML is considered very feasible to be used as a learning media for the circulatory system of class XI.

The advantages of CSML from similar learning media make CSML considered feasible to use as a learning media for class XI circulatory system material. The advantages of CSML in the material aspect are: 1) seen from the aspect of content feasibility, the material on CSML is presented in full using concise, clear, and simple language; 2) seen from the aspect of presentation of material content, CSML is presented systematically per sub-chapter and is equipped with illustrations, images, videos, tables, and representative graphics that make it easier for students to learn the material.

3. Teacher and Student Response to Circulatory System Mobile Learning (CSML)

The CSML trial on a limited scale was conducted on biology teachers and students. Teacher and student responses to CSML are described as follows.

1) Teacher Response (TR)

CSML trial on a limited scale was conducted on 2 biology teachers. The results of the teacher's response to CSML are presented in Table 4.

Table 4.

Teacher Response Results

Assessment Aspect	Response Per Aspect (%)	Category
Content Feasibility	90.63	Very good
Presentation of Material Content	89.26	Very good
App View and Design	87.05	Very good
Language	91.67	Very good
Usability	93.75	Very good
Compatibility	87.50	Very good
Benefits	87.50	Very good
Average Percentage of Overall Responses (%)	**87.02**	**Very good**

Table 4 shows the results of 2 biology teachers' responses to 7 aspects of CSML assessment which have an average percentage response as follows: content eligibility aspect 90.63%, material content presentation aspect 89.26%, appearance and application design aspect 87.05%, language aspect 91.67%, usability aspect 93.75%, compatibility aspect 87.50%, and benefit aspect 87.50%. The average percentage of overall response is 87.02% with a very good category.

The average percentage of teacher responses to all aspects of CSML assessment is 87.02% with a very good category. The results of teacher responses are in accordance with the results of the analysis of several previous studies. Similar previous studies such as android-based multimedia modules on class X biodiversity material that were tested on teachers obtained a response of 87.50% with a very

good category (Baidlowi et al., 2016). Android-based applications in biology subjects at SMP Islam Bakti 1 Surakarta which were tested on teachers received a response of 90% with a very good category (Koderi, 2015). Based on the results of the analysis of teacher responses in similar previous studies, CSML is considered very good to be used as a medium for learning the circulatory system of class XI.

2) Student Response

The CSML trial on a limited scale was conducted on 65 students of grade XI MIPA at one of the Public Senior High School in Surakarta. The results of the student interviews are summarized in to two points below:

a. The appearance of CSML is very good and the presentation of the material is very complete and clear. The presentation of evaluation games, videos, images, tables, and illustrations makes CSML very interesting and fun, and the material becomes easier to understand.

b. Some suggestions from students on CSML are that improvements need to be made to the access speed of using the application, providing videos using Indonesian, and improving the color of some less legible writings because they collide with the basic color of the application.

Meanwhile the results of student responses to CSML by using a questionnaire are presented in Table 5.

Table 5.
Student Response Results

	Maximum Score	Score Acquisition
Total Score	5460	4835
Average Student Response (%)	88,55	
Category	Very good	

Table 5 shows the results of student responses to CSML. Student responses to CSML include 7 aspects, namely aspects of content feasibility, aspects of material content presentation, aspects of application appearance and design, language aspects, usability aspects, compatibility aspects, and benefit aspects. Measurement of each aspect is carried out using the assessment indicators used by the teacher.

The average percentage of student responses to all aspects of the CSML assessment was 88.55% with a very good category. The results of student responses are in accordance with the results of the analysis of several similar previous studies, such as android-based mobile learning on the material of the body's defense system which was tested on students obtained a response with a percentage of 94% which was interpreted as very good. (Gagese et al., 2018). Android-based mobile learning on the material of the body's defense system which was tested on students of SMA Negeri 1 Depok, Sleman Regency, Yogyakarta Special Region, obtained a response of 3.26 with a very good interpretation according to Mardapi (2008) (Surahman, E., & Surjono, 2017). Mobile learning based on e-books on plant structure material obtained a student response of 83.14% which was interpreted as very good (Budi Utomo et al., 2018). Mobile learning based on android application on nervous system material which was tested on 11th grade students of SMA Negeri 1 Mojokerto City obtained a response of 86.5% with a very good interpretation (Arsiyanti & Widodo, 2018). Mobile learning based on android applications applied to class XI SMA Negeri 1 Mojokerto City is effective in improving learning outcomes of nervous system material (Arsiyanti & Widodo, 2018). Based on the results of analyzing student responses in similar previous studies, CSML is considered very good to be used as a medium for learning the circulatory system of class XI.

CONCLUSION

The conclusions of the research on the development of Circulatory System Mobile Learning (CSML) are 1) Circulatory System Mobile Learning (CSML) developed using the ADDIE model can be accessed via communication devices online; 2) the results of validation of the feasibility of CSML from media experts of 82.27% with a very feasible category and material experts of 89.59% with a very feasible category; 3) the results of teacher responses to CSML were 87.02% with a very good category and student responses to CSML were 88.55% with a very good category.

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