Liver_as_excretory_organ

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Research Article

"Liver as excretory organ": Developing Android-based flash learning media for middle school students

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Abstract: Studying the liver as an excretory organ is still a problem for students. The availability of learning media that can represent learning is urgently required. This study aims to develop and analyze the feasibility and practicality of Android-based flash learning media on the liver as an excretory organ for eighth-grade students. This Research and Development (R&D) uses the Borg and Gall model with a limit of up to stage seven. The results of expert validation show that learning media is included in the "very feasible" category according to media experts and material experts, with the percentage order of 86% and 95%. The media practicality by the teacher's response showed that media was categorized as very practical (94%). Then, student response toward the media was reached 85% and categorized as practical. The test of the effectiveness of learning media on critical thinking skills showed that there was a significant difference between the pretest and posttest scores. The results of this study need to be continued at the next R&D stage to get the feasible product.

Keywords: android-based flash media; excretory organ; learning media; liver

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1. Introduction

Misconceptions are one of the problems that arise in the learning process (Ardiyanti & Utami, 2017; Bukit, 2011; Hidayati et al., 2015; Khairaty et al., 2018). Students' misconceptions are caused by various things, both students (Ardiyanti & Utami, 2017; Khairaty et al., 2018), teachers (Bukit, 2011; Chaniarosi, 2014), and learning resources (Agustina et al., 2016; Fajriana et al., 2016; Hidayati et al., 2015). As in biology learning, some materials often have misconceptions issues due to students' understanding. It is considering less factual learning resources in presenting the information.

One of the biology materials that find difficult for students to accept and causes misconceptions are related to the liver as an excretory organ. The results of an interview with a science subject teacher for eighth grade, namely Mr. Abdul Karim Ibrahim, S.Pd on July 12th, 2021, it is known that there are no learning media that can help teachers on the material of the human excretory system, especially the liver. The learning process related to the liver as an excretory organ has not achieved the learning objectives. The first objective is students can connect the structure and function of the liver. The second one is students can outline the process of the excretory system in the liver. The last objective is students can solve problems regarding excretory system disorders that occur in the liver. It is necessary to develop learning media that can help students to achieve learning objectives.

Appropriate learning media must be able to provide the information needed by students. In addition, the media, which can also act as a learning resource, must be following current technological developments (Ferrer-Torregrosa et al., 2015; Firdausi et al., 2017; Li et al., 2019; Pimmer et al., 2013; Wu et al., 2019). The industry 4.0 towards industry 5.0 era marks by the rapid development of technology, information, and digital systems

(Nilasari, 2019). One of the uses of technology in the learning process is by using learning media. Learning media is one of the important components in the teaching and learning process (Lee, 2010; Marlina et al., 2018; Oyedele et al., 2013; Sakat et al., 2012). According to Mahnun (2012), learning media is able to provide convenience for students and teachers in the process of delivering information. Learning media that are widely used by teachers in the teaching and learning process are laptops, LCDs, torsos, and power points (Qumillaila, Susant, and Zulfiani., 2017). One application for making flexible learning media is Adobe Flash CS 6 (Effendi & Hendriyani, 2018). The advantages contained in the application has a combination of text, graphics, animation, audio, video, detailed illustrations, animations created require little memory, layouts are made according to developer creativity, and navigation buttons can be made (Zairana et al., 2020).

The utilization of learning media is expected to be following learning needs. So that it can stimulate students' motivation or interest in learning (Firdausi et al., 2017; Liao et al., 2019; Permata et al., 2019; Widiansyah et al., 2018). Students' interest in the learning process will indirectly affect their critical thinking skills (Lemos & Veríssimo, 2014; Zubaidah et al., 2018). Critical thinking skills are important to be possessed by students today. The student's critical thinking skills can be used to understand concepts, apply, synthesize, evaluate information, and conduct an assessment of what is received or produced (Permana et al., 2019; Zubaidah et al., 2018).

Adobe Flash CS 6 is a tool for learning media development. Previous development research using Adobe Flash CS6 on human excretory system materials was carried out by (Maghfiroh & Hidayati, 2020) in developing STEM-PjBL-based media. Jannah et al. (2021) are also using Adobe Flash CS6 in developing digital teaching materials. In addition, Zairana et al. (2020) are using it to develop interactive multimedia. However, this development of learning media can only be used with computers/laptops that have the Adobe Flash CS6 program and make it a little difficult for students to be able to study independently. Anggraini et al. (2019) suggest that interactive multimedia could be made based on Android. Utilizing Android-based media does not require complete facilities at school and can make it easier for students to learn anywhere and anytime.

Weaknesses and suggestions from previous development studies have made researchers develop learning media in the form of adding Android-based Edu-game. With the development of Android-based learning media, students can learn independently. Edu-game contains quizzes in the form of games in the form of drag and drop, matching, and multiple-choice puzzles so that students can think critically. This study aims to produce appropriate Android-based learning media according to material experts and media experts, determine the practicality of learning media according to teachers and students, and determine the effectiveness of Android-based learning media to accommodate students' critical thinking skills.

2. Materials and Methods

The Research and Development (R&D) of Android-based flash learning media uses the Borg and Gall model (Borg and Gall., 1983), limited to stages 1 to 7 (Figure 1).

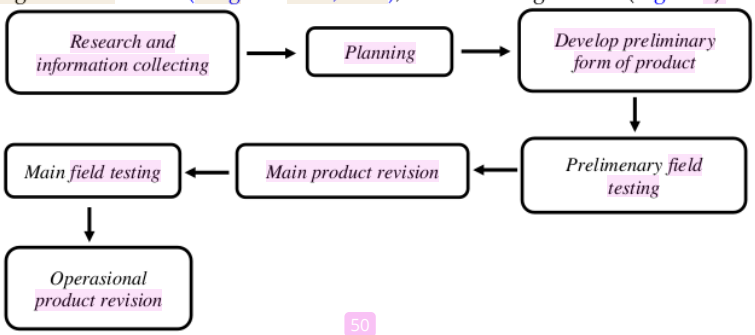


Figure 1. Stages of the Borg and Gall model

The data in this study are qualitative and quantitative. The research instruments used for data collection included interview sheets, response questionnaires, and students' critical thinking ability test questions. The data analysis technique in this study was qualitative descriptive analysis and quantitative descriptive analysis. Analysis of quantitative data will be measured using a Likert scale consists of 5 assessment categories as shown in Table 1.

Table 1. Rating category of the response questionnaire

Category	Score
Excellent	5
Good	4
Average	3
Poor	2
Very poor	1

This research and development time takes place from July-November 2021. The development research procedure describes the steps taken to develop or produce a product, including:

2.1. Research and information collecting

The first step that must be done is to do a literature study and a preliminary study. The collecting data through interviews with students and teachers about the use of learning media. This activity was carried out at SMP (*Sekolah Menengah Pertama* – Junior High School) Muhammadiyah 8 Batu.

2.2. Planning

The planning step is to determine basic competence, indicators, and materials include in the learning media product.

2.3. Develop preliminary form of product

In this step, researchers can arrange the product design for making flowcharts and storyboards clearly, making products while paying attention to the concept and suitability of the material to finishing the product. The final result at this stage is the initial product model to be consulted with the supervisor. Then validation will be carried out by material experts and media experts to obtain responses about the feasibility of the product to be tested. Furthermore, the result of validity from material experts and media experts is calculated using the following Formula (1). The percentage of validation results was then measured from the media eligibility criteria that have been determined (Hestari, 2016), as shown in Table 2.

$$\text{Percentage of validation results} = \frac{Total\ score\ obtained}{Maximum\ score} \times 100\% \quad (1)$$

Table 2. Qualifications and descriptions for the percentage of validation results

Percentage (%)	Qualification	Description
81 – 100	Very valid	Very feasible, no need to revise
61 – 80	Valid	Feasible, need a little revision
41 – 60	Medium valid	Feasible enough, needs to be revised
21 – 40	Reasonably valid	Not feasible, needs to be revised some parts
0 – 20	Invalid	Very not feasible, need a lot of revision

2.4. Preliminary field testing

The initial field trial was carried out using a random sampling technique. There are five students from eighth grade in SMP Muhammadiyah 8 Batu were selected to determine the feasibility of the learning media. This initial field trial can be carried out

repeatedly to produce a suitable design for learning. At this stage, the practicality data of the media is collected. The practicality test was obtained from the students and science teachers as respondents. The percentage of practicality will calculate using a Formula (2). The percentage of media practicality is then categorized according to the assessment category determined by Hestari (2016) as shown in Table 3.

$$\text{Percentage of practicality} = \frac{Total\ score\ obtained}{Maximum\ score} \times 100\% \quad (2)$$

Table 3. Categorization for the percentage of practicality test

Percentage (%)	Category
85 – 100	Very practical
70 – 84	Practical
60 – 69	Quite practical
50 – 59	Less practical
0 – 49	Impractical

2.5. Main product revision

Product revision is done by looking at the responses from media experts, material experts, and initial field trials. The revision process was carried out more than once until a learning media product was obtained that was ready for field trials with a wider range of respondents. The revised product draft is called a hypothetical product because its effectiveness has not been proven and will be known after field trials.

2.6. Main field testing

Main field testing was conducted to determine the practicality and effectiveness of learning media on students' critical thinking skills. This trial involved 25 students of eighth grade in SMP Muhammadiyah 8 Batu. The research design used is one group pretest-posttest to determine the effectiveness of critical thinking skill levels. The results of students' tests were analyzed using the SPSS application with the paired t-test method. The Shapiro-Wilk normality test was chosen to determine the distribution of the data. Furthermore, if the results of the t-test obtained significance < 0.05, it is stated that there is an average value of pretest and posttest.

2.7. Operasional product revision

This step is the second improvement after the field trial. This product revision is carried out to strengthen and improve the product based on the results of the assessment.

3. Results

The results of this study are Android-based learning media products that can be used practically. The detailed description for each R&D stage is explained as follows:

3.1. Research and information collecting

The first step is the selection of materials that will be developed as media based on the problems found in schools. Researchers studied the lesson plans and the syllabus used. Interviews with teachers were also conducted. So, the appropriate material to develop a proper learning media is obtained. The findings revealed that the material related to the human excretory system, especially the liver organ, requires learning media. There are no specific media related to the "liver as an excretory organ" available in schools. Teachers often have difficulty explaining the concept of the liver as an excretory system to students. Learning this material is usually carried out through discussions that utilize various learning resources, both textbooks and sources from the internet.

3.2. Planning

The planning stage is carried out by determining the basic competencies, indicators, and materials used in the learning media product. Based on the results in the first stage, the liver as an excretory organ material still requires supportive learning media. This material is consistent with the basic competence of "analyzing, understanding, and efforts to maintain the health of the excretory system in humans". While the indicators that have not been achieved in these basic competencies are: (1) linking the structure and function of the liver, (2) making an outline of the process of the excretory system in the liver, and (3) solving problems regarding excretory system disorders that occur in the liver. This material is found in the science class of even semester in eighth grade following the 2013 Curriculum in Indonesia. The developed media will accommodate the indicators that have not been achieved.

3.3. Develop preliminary form of product

The developed learning media was heeding the flowchart and storyboard designs. The flowchart can be seen in Figure 2. The results of the development of media that are following flowcharts and storyboards can be seen in Figure 3, Figure 4, Figure 5, Figure 6, and Figure 7.

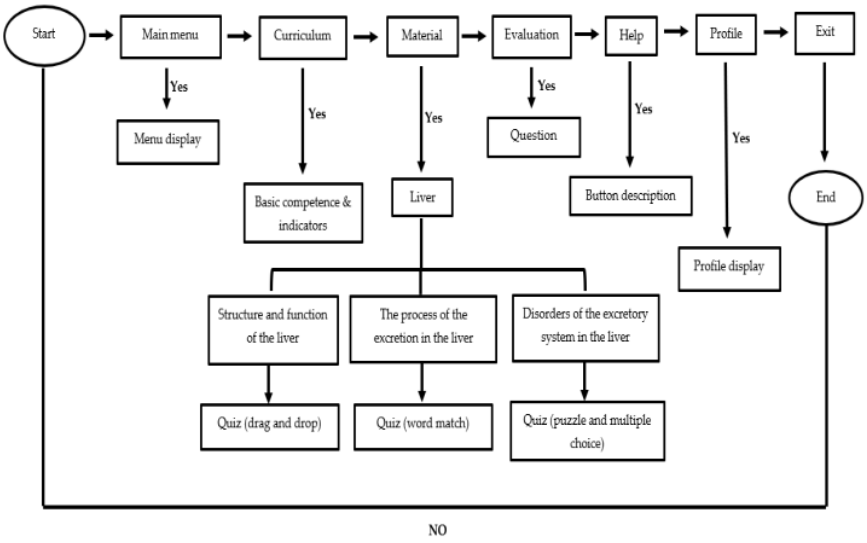
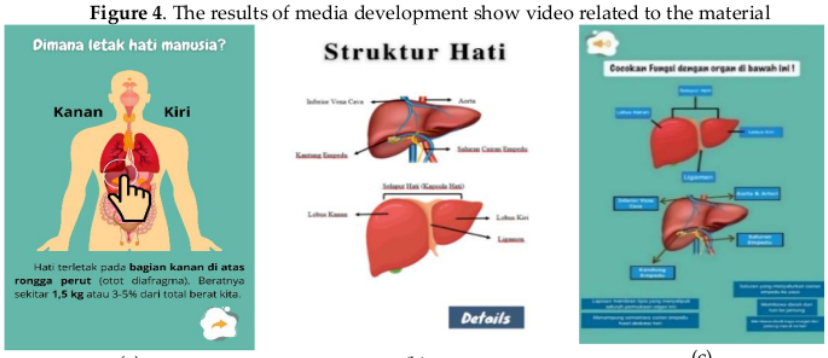


Figure 2. The flowchart of learning media development

(a) (b) (c)

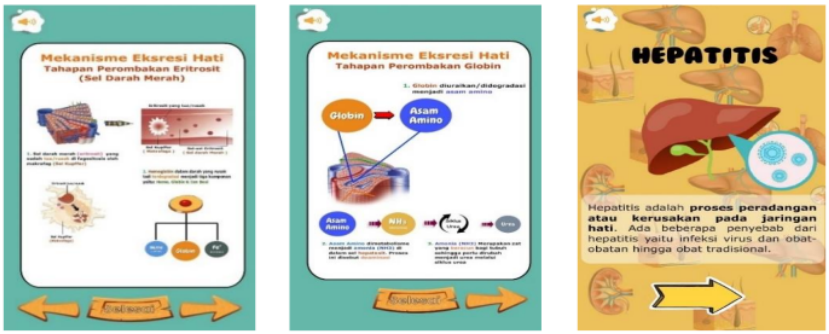
Figure 3. The results of media development show the introduction (a), the main menu (b), and the main content (c).

Figure 4. The results of media development show video related to the material



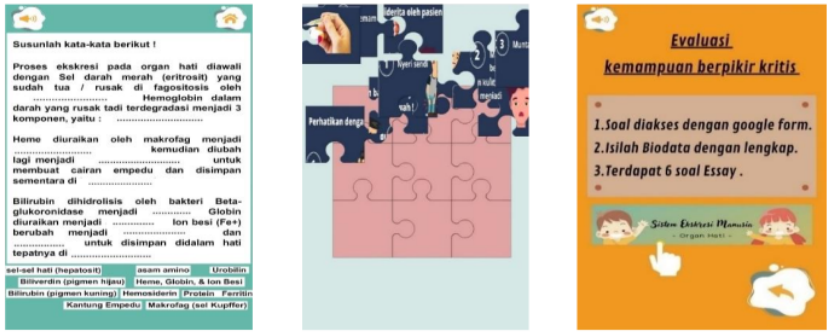
(a) (b) (c)

Figure 5. The results of media development show the sub-material (a, b) and the "drag and drop" quiz (c).



(a) (b) (c)

Figure 6. The results of media development show the e-book (a, b) and pop-up of sub-material (c).



(a) (b) (c)

Figure 7. The results of media development show the word match quiz (a), puzzle quiz (b), and the evaluation linked to google form (c).

The validation by media experts was carried out by two expert lecturers, namely Tutut Indria Permana, M.Pd (Lecturer of the Department of Biology Education, Universitas Muhammadiyah Malang) and Zamah Sari, S.T, M.T (Lecturer of the Department of Informatics Engineering, Universitas Muhammadiyah Malang). The validation instrument is consisting of two aspects. Two aspects were assessed, namely the effectiveness of using the product and the media appearance. The results of media experts' validation got a total score of 129, while the maximum expected score was 150. The percentage of validation results reached 86% and was categorized as a very feasible category.

The validation of the material expert was carried out by Dr. Nurul Mahmudati, M.Kes (Lecturer of the Department of Biology Education, Universitas Muhammadiyah Malang). The instrument consists of two aspects (content and language). The validation results show that the total score obtained is 71, while the maximum score is 75. So, the percentage of material validation results is 95%. It is included in the very feasible category.

3.4. Preliminary field testing

The preliminary field-testing phase involved five eighth graders. In this stage, the student response questionnaire is distributed to the respondent. The result of the preliminary field testing, based on four aspects of the assessment, is shown in Table 4. The results show that the average percentage of student responses in the preliminary field testing can reach 92%. It can be categorized as a very feasible category.

Table 4. The result of the preliminary field testing

No.	Aspect	Score (%)	Category
1.	Generate student interest	92	Very feasible
2.	Material suitability	91	Very feasible
3.	Appearance	88	Very feasible
4.	Conformity with learning objectives	95	Very feasible
Average		**92**	**Very feasible**

The practicality test of the media was carried out by measuring the responses of teachers and students. One of the science teachers at SMP Muhammadiyah 8 Batu, namely Abdul Karim Ibrahim, has a role as a teacher respondent. The teacher response instrument includes three aspects (effectiveness, content, and appearance). The total score obtained is 69, while the maximum expected score is 75. So, the percentage of practicality is 92% which is categorized as very practical. The same results were also obtained from students' responses which stated that the media was included in the very practical category. The percentage of the practicality of student responses reached 85.3%.

3.5. Main product revision

Main product revision is done by adding some evaluation questions. Some indicators have not been measured through the developed evaluation questions. So that appropriate questions are added to measure the achievement of these indicators.

3.6. Main field testing

Main field testing was conducted to determine the practicality and effectiveness of learning media on students' critical thinking skills. The results of this effectiveness test are to measure the level of students' critical thinking skills from the Android-based learning media developed. The effectiveness test is seen from the students' pretest and posttest scores. The questions consist of six essay questions related to a liver as an excretory organ. The results of the t-test are presented in Table 5.

Table 5. The t-test result of students' critical thinking skills

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
pretest – posttest	-32.280	24.697	4.939	-42.475	-22.085	-6.535	24	.000

The results of the t-test showed that the sig value was less than 0.05 ($p < 0.05$). There is a significant difference between the students' pretest and posttest scores. So, there is a significant effect related to the use of the Android-based flash learning media on the critical thinking skills of eighth-grade students of SMP Muhammadiyah 8 Batu.

3.7. Operasional product revision

In this seventh stage, a small revision was made regarding the evaluation link. The final evaluation question is connected to the Google form that consists of six essay questions. The Google form setting regarding filling it out needs to be changed so that students can only fill it out one time.

4. Discussion

The results of this research and development are Android-based flash learning media for middle school students related to the liver as an excretory organ. Adobe Flash CS6 is a program used for media creation. Learning media is developed following learning indicators that have not been achieved. The validation results of learning media by two media experts and one material expert resulted in the same assessment. All of them stated that the media is included in the very feasible category with a validation percentage of 86% and 95%, respectively. It can be concluded that the Android-based flash learning media developed is categorized as very feasible and does not need to be revised. Android-based interactive learning media provides convenience for students. Students will feel interested in the media, make easy for them to understand the content (Anwariningsih & Ernawati, 2013; Firdausi et al., 2017; Liao et al., 2019; Sharma & Pooja, 2016; Widiansyah et al., 2018). The developed media is also flexible for students. Students can use it easily through their cell phones (Farida et al., 2018; Qumillaila et al., 2017; Ramadhani et al., 2016; Rasyid et al., 2019; Widiansyah et al., 2018). Students can learn anytime and anywhere.

In the preliminary field testing, four aspects are assessed. The first aspect is generating student interest which reaches 92%. The second aspect is the suitability of the material with a percentage of 91%. The next aspect is related to appearance reach 88%. And finally, the conformity with learning objectives aspect obtained 95%. The average preliminary field-testing results reached 92% (very feasible category) and did not need revision. Then, the practicality test of learning media was carried out by filling out response questionnaires by students and teachers. The science teacher's response obtained a percentage of 92% that was categorized as very practical. The results of student responses reached a percentage of 85.3% including in the practical category. In today's era, interactive learning is very suitable to be applied (Amory, 2014; Anwariningsih & Ernawati, 2013; Liao et al., 2019; Nugraini et al., 2013; Putra et al., 2017; Sadikin et al., 2020). Students tend to be more interested in interactive learning. Audio and visual components combined with animation are more effective in attracting students' attention (Islam et al., 2014; Kusuma et al., 2015). In addition, the combination of images, animations, and videos causes appearance media to get a positive response.

The results of the t-test analysis showed that there was a significant difference between the students' pretest and posttest scores. There is a significant effect of using Android-based flash learning media on students' critical thinking skills. Rasyid et al. (2019) state that android-based media can affect students' critical thinking skills. Students gave a positive response to the use of Android media (Winata et al., 2019). Ngurahrai et al. (2019) added that mobile learning-based learning media can improve critical thinking

skills so that they can be used as alternative media for learning. The addition of Android-based Edu-games in the form of drag and drop quizzes, matching, and puzzles can be a place to develop students' critical thinking skills. Learning with android-based learning media makes students happier in learning because it is packed with games (Firdausi et al., 2017; Rasyid et al., 2019). With the high interest and learning motivation possessed by students, the learning outcomes obtained by students also increase.

5. Conclusions

The resulting development product is in the form of non-printed learning media based on Android that contains material on the liver as an excretory system and parameters that measure the effectiveness of students' critical thinking skills. The limitation of development in this research is the research model used by Borg and Gall in the seventh stage. The results of expert validation show that learning media is included in the "very feasible" category according to media experts and material experts, with the percentage order of 86% and 95%. The media practicality by the teacher's response showed that media was categorized as very practical (94%). Then, student response toward the media was reached 85% and categorized as practical. The test of the effectiveness of learning media on critical thinking skills showed that there was a significant difference between the pre-test and posttest scores. The results of this study need to be continued at the next R&D stage to get the feasible product.

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Conflicts of Interest: We declare that there is no conflict of interest

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