

Developing multimedia-based learning media on the digestive system using Adobe Flash Professional CS6 application for class XI

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Abstract: This study aims to develop and test the feasibility of multimedia-based learning media for the concept of the human digestive system using Adobe Flash Professional CS6. This research and development (R&D) use the ADDIE development model. The development carried out in this study is limited to the 7th step, including problem identification, data collection, product design, design validation, design revision, product testing, and product revision. The subjects of this study were determined by using random sampling. Data collection was carried out by non-test techniques using interview guide sheets, validation questionnaires from media and material experts, and student response questionnaires. The results showed that the feasibility test of the product developed based on the material was in the excellent category of 91%. Furthermore, the results showed that the feasibility test of the product developed based on the assessment of media experts was feasible with 87.5%. User-based due diligence through limited trial also showed decent results with 97.7%. These results indicate that the multimedia-based learning media developed using Adobe Flash Professional CS6 is feasible for mass production after the final revision.

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1. Introduction

The learning process is a dialogue process between teachers and students. The teacher acts as a learning facilitator who provides a meaningful learning experience for students (Calleja & Camilleri, 2021; Shaaruddin & Mohamad, 2017). Meaningful learning needs to be done with good planning, one of which is preparing innovative media (Desouza, 2017; Opara & Oguzor, 2011). According to experts, using relevant media will provide scaffolding for students in understanding complex material (Chajjaroen et al., 2012). According to Anjarwati et al (2016); Oyedele et al (2013), learning media as a means of communication in the learning process must be carried out to achieve optimal learning outcomes. Curriculum achievements must cover the challenges of digital literacy and the 4.0 industrial revolution (Bialik et al., 2015; Conde & Sánchez, 2010). The 4.0 literacy industrial revolution is technological literacy that improves the ability to read, analyze, and use information in the digital world. (Hossain et al., 2018; McKechn & Ellis, 2014), the learning challenge in the industrial revolution 4.0 is the integration of information technology in the learning process. The application of technology in education can be realized by designing IT-based learning media, which is expected to foster student activity in the learning process. Binkley et al (2014); Fitriani et al (2017); and Waqar (2013) said that 21st Century teachers need to design learning by utilizing technology as an innovation in teaching. Hira and Anderson (2021) said that one of the IT-based learning media is Adobe Flash media.

The development of innovative learning media based on the use of technology has been widely carried out (Bahri et al., 2020; Chu et al., 2016). The learning media innovations developed are not only for increasing the variety of media but also for fulfilling contextual-based needs. The contextually of a material with everyday life is an important variable considering the differences in media needs in each school (Anstey, 2017; Asrizal et al., 2017).

On the other hand, media development also depends on the teacher's ability to develop ideas in innovative media design (Fauziyah & Jailani, 2014; Glaze, 2018; Rajagukguk & Simanjuntak, 2015). Teachers need to analyze the learning barriers they face, as well as identify potential learning improvements that can be made at the same time (Gunuc, 2014; Saeed & Zyngier, 2012). In some areas, the use of innovative learning media is limited to power point and learning video media sourced from the internet, so that often the media used is not necessarily relevant to what students need or is not relevant to the learning objectives that have been set. Wahyuni et al (2013), material on the digestive system is complex because it studies various physiological phenomena that cannot be observed directly, such as the process of digesting food. These conditions need to be anticipated by the teacher by ensuring the use of media that can provide a concrete learning experience. The material presented is concrete and will be easily understood by students in the learning process.

Based on the curriculum analysis, the learning media that will be developed can be in the form of information technology-based learning media, following the demands of the 2013 curriculum, which requires students to be able to use technology, which is implemented in multimedia-based learning media (Degeng et al., 2017). Submission of material is a physiological process that does not appear to be done using creative visualization so that the process can make it easier for students to build the concept being studied. The development of media based on creative visualization has been widely carried out using Adobe Flash. However, the observations made at SMAN 2 Pandeglang show that the availability of innovative media that presents creative visualization is quite limited. On the other hand, the media that explains the digestive system concept is also limited to the use of media sourced from the internet. Therefore, this study aims to develop learning multimedia using Adobe Flash Professional CS6 on the digestive system concept.

2. Materials and Methods

The research method used in this research is research and development. The steps of this development research model follow the steps of the development (Sugiyono, 2015) as mention at Figure 1.

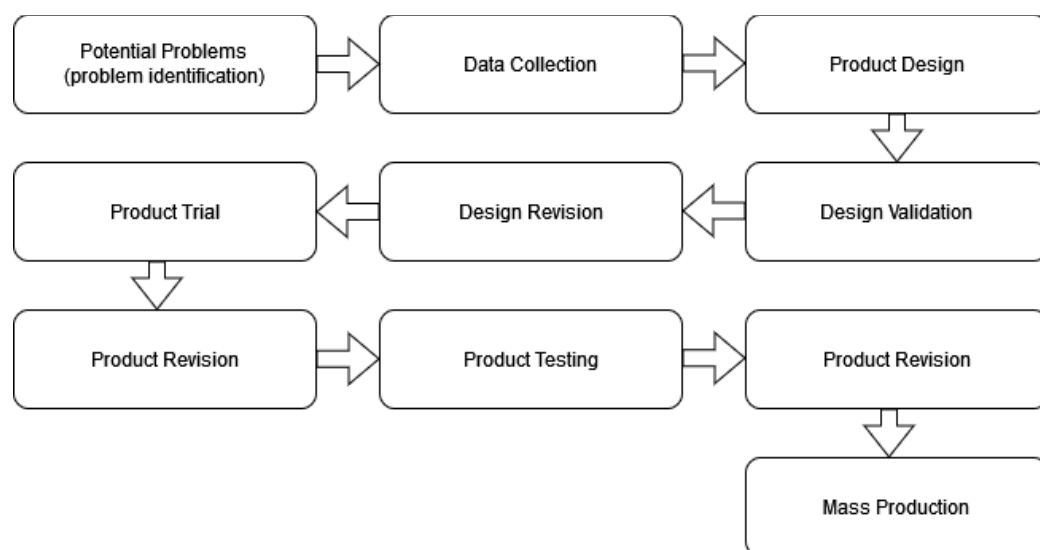


Figure 1. The steps for using the research & development method

2.1 Potential problems

Learning tools, especially multimedia-based learning media, are needed because the learning process for digestive system material only uses learning media in the form of PowerPoint and learning video media sourced from the internet. Meanwhile, the digestive system is a complex material to study because it has events that cannot be observed directly, such as the process of digesting food.

2.2 Data Collection

Data collection is done by literature study and observation. Collecting data to determine the developed multimedia-based media's needs, characteristics, strengths, learning, and weaknesses.

2.3 Product Design

The product design to be developed is media designed with the Adobe Flash Professional CS6 application in exe and apk format. In addition, product design considers aspects of easy user access (interface) and attractiveness to stimulate student learning motivation. Besides that, the contextual aspect of the material is also a fundamental thing that forms the basis for the development of media design.

2.4 Design Validation

Design validation was carried out to assess the developed multimedia-based media product. The assessment is carried out based on rational thinking before product testing is carried out. At this stage, the product is assessed by media experts and material experts. Each expert was asked to assess the designed product so that they could assess the advantages and disadvantages of the product. Material experts must have qualifications as university lecturers in relevant fields, in this study, biology studies. Media expert qualifications have knowledge and skills in the field of multimedia.

2.5 Design Revision

After the product has been validated, the product is revised according to the data validated by experts. The things that are identified are still considered lacking in the product to be corrected and adapted to the relevant context.

2.6 Product Trial

Product trials are used to evaluate previously revised products, and at this stage, trials are carried out in small groups involving 10-20 students. At this stage, data collection was also carried out using a student response questionnaire to obtain input and revise the final product.

2.7 Product Revision

Product revision was carried out based on the results of a student response questionnaire conducted by small groups. Product revision is carried out comprehensively to produce a perfect product and is ready to be implemented in a broader perspective.

The research was conducted at the FKIP of Universitas Sultan Ageng Tirtayasa and Senior High School 2 of Pandeglang, Banten Province. The research was conducted in August - November 2020, covering product development, validity testing, and limited testing. The subjects in this study were students of class XI mathematics and science as users who were developed for limited trials. Student samples were taken using a random sampling technique to obtain 20 students in class XI-4. The instrument used in this research is a questionnaire, including three types according to the respondents from the study. The questionnaire is used for material experts, media experts, and students' questionnaires. The scope of assessment in this assessment is the learning aspect and the content aspect,

the display aspect, and the programming aspect, as well as the usability aspect. Instrument scoring sheets measure attitudes, opinions, and perceptions of a person or group of people about social phenomena (Sugiyono, 2015), following are the scoring rules (Table 1).

Table 1. Scoring rules

Level	Score
Very good	5
Good	4
Enough	3
Poor	2
Very poor	1

The following is the media assessment based on the results of media expert tests, materials, and data processing techniques used according to Sugiyono (2015):

$$NP = \frac{R}{SM} \times 100\%$$

Where NP: Percentage value of eligibility sought or expected; R: Raw score value obtained; SM: Maximum score; and 100%: Fixed number.

The assessment results obtained are then interpreted according to Table 2.

Table 2. Feasibility test criteria

Score (%)	Description
81 - 100	Very worthy
61 - 80	worthy
41 - 60	Enough
21 - 40	Less
0 - 20	Not

3. Results

The results of the product developed are in the form of multimedia-based learning media for the concept of the digestive system of class XI students. Multimedia-based learning media has a component such as cover (Figure 2). The menu contains options consisting of essential competencies, learning indicators, concept maps, materials, evaluation, exit applications, developer profiles, and information (Figure 3). The menu contains a selection of components consisting of a food submenu that explains the meaning of food ingredients: carbohydrates, fats, proteins, vitamins, and minerals, and their functions for the body. This digestive tool submenu explains the meaning of the digestive system, digestive tract, and glands, and the digestive process submenu, which describes the process of digestion in general (Figure 4). Then there is an evaluation submenu that contains practice questions to assess students from a cognitive perspective and a developer profile submenu.

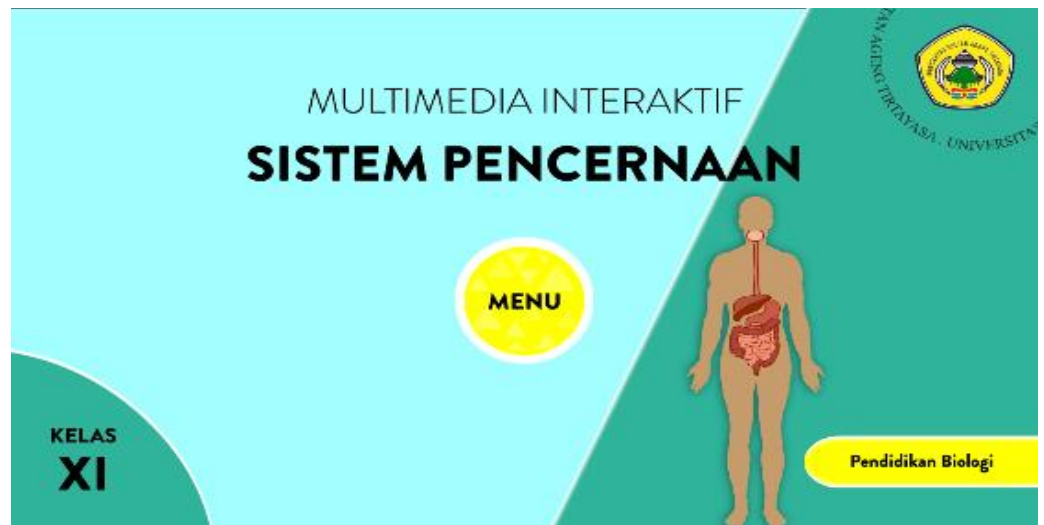


Figure 2. The main interface of the multimedia

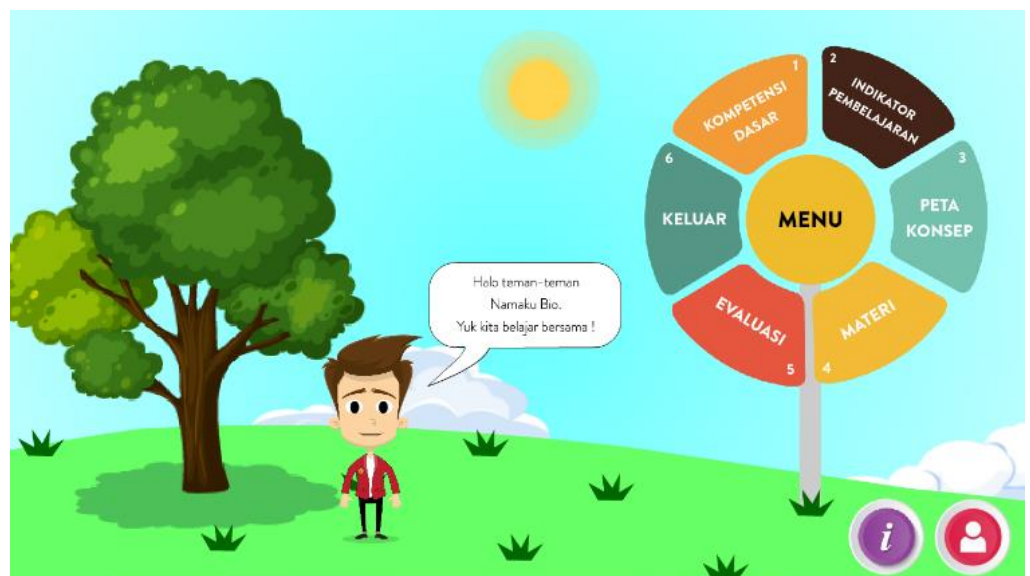


Figure 3. The main menu



Figure 4. The learning content of multimedia

Material expert validation and media expert testing involved one material expert and one media expert with a lecturer background. The teachers, media experts, and material experts are Lecturers in the Biology Education Department Sultan Ageng Tirtayasa University. Material experts assess learning and content aspects with the criteria of conformity of content with the 2013 curriculum, evaluation, quality of learning, completeness of images, animation, interactivity, display of learning media content, and frames for learning media content, use of language. Meanwhile, media experts assess the appearance and programming aspects with the criteria of navigation, writing quality, display quality, flexibility, interactivity, evaluation, media integrity, and the entire program. The material validation results are in Figure 5, while the media expert test validation (Figure 6), and student response (Figure 7).

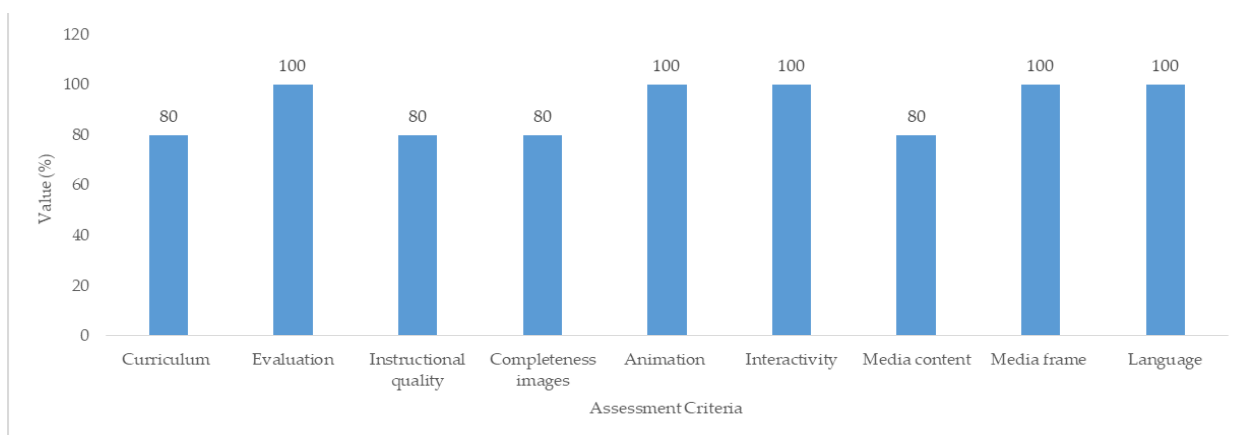


Figure 5. The result of material expert test

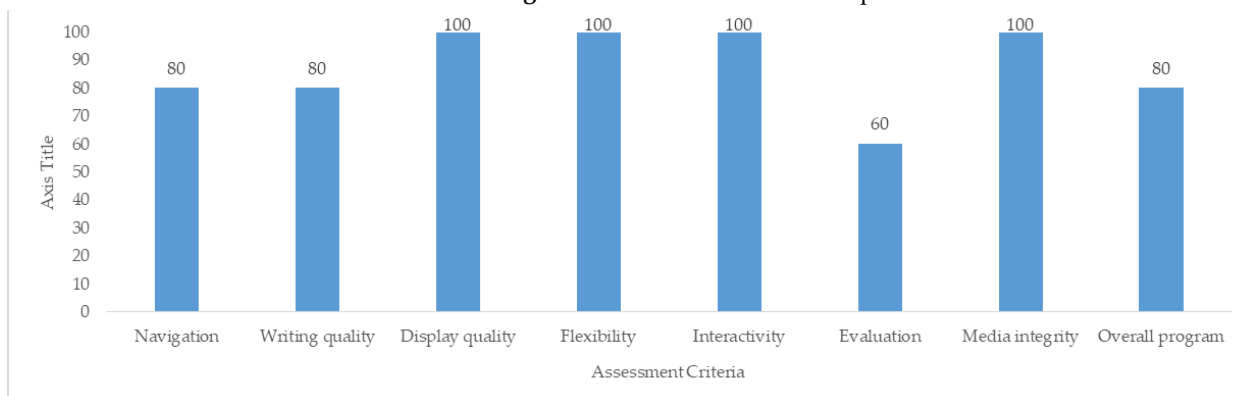


Figure 6. The result of media expert test

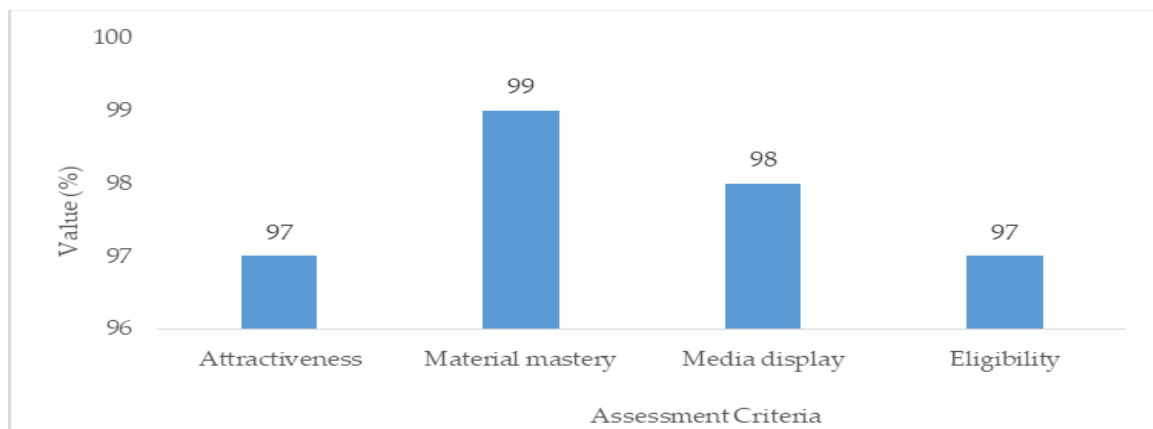


Figure 7. The result of the student response test

4. Discussion

Based on the material expert validation results in [Figure 5](#), the percentage of content conformity with the 2013 curriculum is 80%. Indicators that meet these criteria are presented following the demands of core competencies (KI) and essential competencies (KD). Furthermore, the concept maps and materials displayed follow the KI and KD and the learning indicators set. The following criteria are evaluation criteria to get a 100% percentage. Indicators that meet these criteria are assessed based on competency indicators, teaching materials that support mastery of concepts, instructions for filling out questions, and student assessments that include cognitive aspects. Based on this explanation, interpreting the assessment criteria is very feasible. These results follow [Sugiyono \(2015\)](#); the criteria are valid if the interpretation is 81-100%.

The percentage of instructional quality is 80%, with indicators that meet these criteria, such as programs arranged systematically, concepts presented in small/special units, and programs that can be used individually, in groups, or classically. While the indicators that have not been fulfilled are instructions for using learning media because, in the material submenu, there are no directions for the material displayed and presented in the learning media, there are only navigation buttons in the form of three houses without explanation and tend to focus on moving car animations. Navigation buttons on learning media must have clear symbols and descriptions because they are intended to make it easier for students to use learning media coherently. According to [Brennan \(2016\)](#); [Muchlis and Putra \(2017\)](#), navigation settings in interactive learning media are essential because one of the characteristics of interactive learning media is the ease of navigation, making it easier for students to learn the contents of their learning media.

The following criterion is the completeness of the image by 80%. Indicators that meet these criteria are the images presented by the concept, the displayed images are relevant, and the images presented are interesting. While the indicators that are not fulfilled are information on image sources because there are image sources outside BlogSpot; according to [Lase \(2019\)](#), publication media such as blogs and WordPress have information that cannot be accounted for because they do not have transparent sources of information. Animation and interactivity criteria also get a percentage of 100%. Indicators that meet these criteria are animation that is presented according to the concept, animation that is very relevant to the concept, and animation that is displayed that is interesting. Animations make it easier to understand concepts. Based on these percentages, the interpretation of animation criteria is very feasible.

Furthermore, the material presented can increase student learning motivation. These results follow [Sugiyono \(2015\)](#); the criteria are feasible if an interpretation of 81-100% is obtained. [Aji et al \(2018\)](#) and [Suprianti \(2020\)](#) stated that learning media would be more interesting if it used animation. On the criteria for displaying the contents of the learning media, the percentage is 80%. The indicators that meet these criteria are the appearance of the background and cover, which is simple and follows the concept, systematic presentation, and the use of colors and icons to clarify the content. At the same time, the indicators that need to be met are fonts because the writing on the learning media is too dense and difficult to read. According to [Mitasari and Gofur \(2017\)](#), the size and type of font greatly determine the readability of the content in the learning media; therefore, avoid using fonts that are too large and types of fonts that are difficult to read.

The following criterion is the criteria for framing the content of the learning media to get a percentage of 100%. The indicators that meet these criteria are the appearance of an attractive frame layout, the display background and content, the display icons and symbols, and the color of harmonious layout elements. Based on the presentation, the interpretation of the criteria for the display frame of the learning media content follows ([Sugiyono, 2015](#)), a criterion that has very worthy if the interpretation obtained is 81-100%.

The last criterion is the criteria for using language to get 100%. The indicators that meet these criteria are writing following the General Guidelines for Indonesian Spelling

(PUEBI), using appropriate and easy-to-understand terms, being communicative, and using language appropriate to student development. Based on the presentation, interpreting the criteria for using language is very feasible. This result follows [Sugiyono \(2015\)](#), a worthy criterion if the interpretation is 81-100%.

Based on the expert tests, the overall results on the material expert test get a percentage of 91%, showing that multimedia-based learning media developed using the Adobe Flash Professional CS6 fall into the very feasible category in terms of material. Based on the results of media expert validation in [Figure 6](#), the navigation criteria get a percentage of 80%. The indicators that meet these criteria are navigation made to make it easier for users to operate learning media, position, navigation forms and buttons that are consistent, and navigation accuracy with the desired menu. While the indicators that still need to be met are that the users are free to choose the submenu they want to learn, there are still navigation buttons that do not work, which makes learning media users not free to choose the sub-menus they want to learn. At the same time, according to [Aji et al \(2018\)](#); [Madeali and Prahani \(2018\)](#), Adobe Flash has advantages: giving students' freedom in selecting menus, materials, and materials.

On the criteria for writing quality, the percentage is 80%. The indicators that meet these criteria are that the writing can be read; clearly, the use of font variations is not excessive, and the font size is consistent (headlines, subheads, text), while the indicators that are not met are the suitability of the text color with the background, color background. According to [Mitasari and Gofur \(2017\)](#), the selection of colors in the text must contrast with the background so that the writing can be read clearly.

The following criterion is the display quality criteria to get 100%. According to student characteristics, the indicators that meet these criteria are systematic learning media, layout consistency and harmony, consistent use of color, and an attractive overall appearance. Based on the percentage, the interpretation of the display quality criteria is very worthy. According to [Sugiyono \(2015\)](#), a very worthy criterion if the interpretation obtained is 81-100%.

On the flexibility, criteria get a percentage of 100%. The indicators that meet these criteria are that anyone can use them, can be used at any time, can be accessed easily without being adrift of space and time, and can be used independently and in groups. Based on the percentage, the interpretation of the flexibility criteria is very worthwhile. According to [Sugiyono \(2015\)](#), a very worthy criterion if the interpretation obtained is 81-100%.

The following criterion is the interactivity criteria to get a percentage of 100%. The indicators that meet these criteria are that the user can control teaching materials, there are dialogical sentences between the program and the user, it requires a bit of typing in the use of learning media, and users can directly answer questions about evaluating the cognitive domain, and the evaluation results are given instantly. Therefore, the interpretation of the interactivity criteria is very feasible based on the percentage. This result follows [Sugiyono \(2015\)](#), a worthy criterion if the interpretation is 81-100%.

On the evaluation criteria, get a percentage of 60%. The indicators that meet these criteria are evaluation questions in the learning media, and users can answer directly about evaluation questions. While the indicators that are not satisfied are that there is incorrect and correct information after working on the evaluation questions, and there is a re-explanation of the wrong questions because there is no inaccurate and accurate information. There is no re-explanation of the question after evaluating the learning media.

The following criterion is the media integrity criteria to get a percentage of 100%. The indicators that meet these criteria are the availability of features in the media that can help user understanding, the multimedia presented is of good quality, the learning media application can be operated on all screen resolutions, and the media presented following existing concepts. Based on the percentage, the interpretation of the media integrity criteria is very worthy, according to [Sugiyono \(2015\)](#), a criterion that is very worthy if the interpretation obtained is 81-100%.

The last criterion is the criteria for the entire program to get a percentage of 80%. Indicators that meet these criteria are instructions for using learning media, application masters are easy to disseminate, and learning media applications are easy to install and uninstall on laptops, computers, and smartphones android. At the same time, the indicators that still need to be met are teaching materials that can be operated without bugs. Bugs are software errors that do not follow the developer's wishes (Huang & Chen, 2013). For example, it is due to a mistake in using the action script application Adobe Flash on the navigation buttons, which causes the button not to be pressed or not work. Based on the expert test that has been carried out, the overall results of the material expert test get a percentage of 87.5%, showing that multimedia-based learning media developed using the Adobe Flash Professional CS6 fall into the very feasible category in terms of media.

Based on the results of the small group trial in Figure 7, the criteria for interest in media get a percentage of 97%, with three indicators having a percentage of 100%, namely this learning media motivates to study harder; this learning media makes independent learning fun; and this learning media gives a sense of interest in learning biology lessons. While indicators do not have a maximum score with a percentage of 80%, this learning media can increase concentration in learning. Three students think this learning media cannot increase learning concentration if used on android. Students are disturbed by notifications on android that come from other applications, so they cannot concentrate while studying. This result can be overcome by disabling cellular data from android, which can avoid notifications from other applications because this learning media can be operated offline. Aji et al (2018); Madeali and Prahani (2018) says that Adobe Flash-based learning media applications are offline.

On the criteria for mastering the material, the percentage is 99%, with three indicators having a 100% percentage; namely, this learning media can provide additional knowledge; systematic presentation of material can help the process of understanding the material according to the speed and ability of students in understanding the material; the features provided can help understand the material. At the same time, indicators that do not have a maximum score with a percentage of 95%, namely, the material presented, can be understood easily. However, one student thinks that the presented material cannot be understood easily because students need to be used to learning independently and still depend on the teacher's direct explanation. Therefore, in line with Sihotang et al (2020), there are still students in Indonesia who need to learn more independently due to certain factors.

The following criterion is that the display criteria get a percentage of 98%, with three indicators having a percentage of 100%, namely the appearance of this media is attractive because it has a harmonious color composition, pictures can help students in understanding the material, and animation can help understanding students about the material. At the same time, the indicators that do not have a maximum score with a percentage of 90% of 20 students, namely the text, can be scanned because the font needs to be more significant for those who operate learning media on android. Following Sulistyono (2016) opinion, the size and type of font greatly determine the readability of the content in the learning media. Furthermore, following Anggita (2021), using animation in learning media can avoid misperceptions during learning because students can understand the material as a whole.

The last criterion, namely the implementation criteria, gets a percentage of 97%, with two indicators having a percentage of 100%. Therefore, the navigation buttons can be used efficiently, and this learning media can be used anywhere and anytime. While indicators that are not met with a percentage of 90%, namely this learning media, make it easier for students to learn the material and indicators that get a percentage of 90%, this learning media is very efficient. Moreover, it does not provide a heavy burden like books because students assume that not all students have androids and laptops capable of operating this learning media. Therefore, some students prefer books as learning resources. While at SMAN 2 Pandeglang already has a computer laboratory that allows students to operate

the learning media with the format .exe. According to Hussin (2018) and Mulyati et al (2021), the challenge in education in the 4.0 revolution era is improving the quality of science learning that is adaptive to technological developments. Adobe Flash is here as an answer to this challenge.

Based on small-group trials that have been carried out, the results of the student response test get a percentage of 97.75%, showing that multimedia-based learning media developed using the Adobe Flash Professional CS6 fall into the Very Eligible category in terms of use.

5. Conclusions

The prototype in the form of a multimedia-based learning media on the digestive system concept for class XI, which was developed using the Adobe Flash Professional CS6, was developed follows the steps of the development Sugiyono model, namely: (1) potential and problems (problem identification) (2) data collection (3) product design (4) design validation (5) design revision (6) product trial (7) product revision (8) usage trial (9) product revision (10) mass production. In this study, it was limited to the 7th step. The product developed consists of the main menu with six components: primary competence button, learning indicator button, concept map button, material button, evaluation button, application exit button, developer profile button, and information button.

The resulting multimedia-based learning media obtained a feasibility value of 91% in the very feasible category in terms of material, getting a score of 87.5% in the excellent category in terms of media and a score of 97.7% in the very feasible category in terms of use. Furthermore, based on expert tests and small group trials, multimedia-based learning media were developed using Adobe Flash Professional CS6, which is feasible for mass production after the final revision.

Author Contributions: For research articles with several authors, a short paragraph specifying their individual contributions must be provided. (Methodology, Arifin, M.F; validation, Rahman, A., Hendriyani, M.E., and Rifqiawatia, I; analysis, Arifin, M.F.; writing—original draft preparation, Arifin, M.F.; review and editing, Arifin, M.F).

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Conflicts of Interest: Declare conflicts of interest.

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