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Development of Interactive Learning Multimedia for Biology Subjects on the Human Blood Circulation System Material to Improve Motivation and Learning Outcomes in High School

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Abstract: Lack of student learning motivation will cause low learning outcomes. One of the students' needs for learning understanding is through appropriate learning media. The development of learning media has a role in improving students' understanding and learning motivation. This study aims to determine the level of feasibility and effectiveness of learning multimedia developed as a biology learning media for the material Human Blood Circulation System for grade XI students. The development model used in this study is ADDIE. Multimedia product testing is carried out in two stages, namely the alpha-beta test used to determine the feasibility of the product and the product effectiveness test to determine the effectiveness of the product in improving learning outcomes and student motivation. The alpha test was carried out by involving two experts in the fields of media and materials. The beta test stage was carried out by involving 1 biology teacher and 5 grade XI students of SMAN 1 Sleman. The effectiveness test stage was carried out by involving 30 students. Data collection techniques were carried out by means of observation, interviews, questionnaires and tests. Data analysis in this study used qualitative descriptive analysis. The results of the product testing obtained an alpha test on media experts with an average value of 3.64 and on material experts with an average value of 3.38 which is included in the very eligible category. The results of the beta test obtained an average value of 3.49 which is also included in the very eligible category. The results of the effectiveness test also showed positive results, namely learning outcomes that increased from an average of 52.2 to 95.8. The learning motivation aspect also showed an increase from the moderate category to high.

Keywords: Critical thinking skills; Education for sustainable development; E-LKPD; Environmental literacy; Problem based learning

Introduction

Students' learning needs are greatly influenced by the context, and one example is the selection of the right media. To support the statement below, the opinion of Ningsih et al. (2022) and McCoy et al. (2012) emphasizes that the use of media in learning activities further improves students' understanding of the material. Moreover, the presence of learning media can further increase student motivation and arouse enthusiasm and interest in the learning process. In line with this statement, according to Pribadi (2023) and Puspitarini et al. (2019), learning media has the potential to increase the appeal of the material so that if it is arranged creatively it can increase student motivation.

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Biology learning becomes interesting for students because of their interest in living and non-living objects, opening up various interesting aspects that trigger their curiosity. Through this material, students are encouraged to explore more deeply the uniqueness of the biological world, broaden their understanding, and enrich their insights. The results of an initial study of 71 grade XI students in SMAN 1 found that 54.9% felt that biology learning was quite difficult, for example in the material on the circulatory system. One of the reasons is because the material is not directly visible or abstract. This makes teachers teach the material with the right explanation so that students can understand it. Interviews with biology teachers showed that they agreed that understanding the circulatory system requires more ability due to the abstract material. Achieving Competence in the material on the circulatory system requires effective learning methods that are in accordance with the quality of the teaching materials. To ensure that students understand the learning material, the learning techniques chosen must also be supported by media that are in accordance with the quality of the learning materials.

The results of the follow-up interview showed that the material on the human circulatory system at SMAN 1 Sleman requires support with learning resources that facilitate the delivery of the material. The learning process, which has so far only been limited to PowerPoint presentations and textbook-based learning methods, can have an impact on students' difficulty in understanding and prevent them from achieving learning goals. The lack of media and technology support in the educational process in the classroom is one of the variables that causes the learning goals that have been set not to be achieved. The results of further interviews with biology teachers showed, for example, that common obstacles in the use of learning media are the lack of media development and monotonous learning. This statement is in line with Lestari (2018) that technology in the context of education is a system that has the ability to facilitate learning with the hope of achieving the desired results. Putri et al. (2022) stated that today's learning needs to be supported through the use of technology to realize Indonesia's progress through achieving educational goals. By utilizing various resources and technologies, we stimulate students' interest and motivate them to learn. The success of the learning process can be achieved through an optimal combination of structured biology learning and the use of quality learning resources (Putri et al., 2024; Garcia-Bonete et al., 2019; Scott et al., 2018).

SMAN 1 Sleman became a trial location for product use. The selection of the research location at SMAN 1 Sleman because its facilities greatly support the use of technology in Internet access. Further observations revealed that students felt that learning was monotonous and boring when they only studied with explanations using a projector. Supporting this statement, Silberman (2019) and Suhelmi et al. (2023) explained that learning feels monotonous if the teacher always uses the same method. Monotonous learning can reduce student enthusiasm and have a negative impact on the achievement of learning activity outcomes (Charline & Frederic, 2023; Liew et al., 2017). Success in teaching and learning activities can be achieved if teachers can manage their classes effectively, including choosing the right learning methods and media according to the needs of students at school (Lasaiba, 2024; Javed, 2023). Based on this statement, creating educational media that can be used responsibly and appropriately on mobile devices can be a solution to monotonous learning. Arsyad (2016) and Muammar et al. (2018) emphasized that the situation, atmosphere, and learning environment can be important supporting tools in carrying out the educational process through the use of relevant learning media. Astatin et al. (2016) and Afniyati et al. (2018) also stated that the presence of learning media in the process of understanding biology has a positive impact on the formation of positive attitudes of students towards the subject and towards the overall learning activities.

One solution to the problem of the lack of biology learning media is to utilize the use of media. In relation to technology and school support, learning materials can be packaged with multimedia or known as learning multimedia. The presence of multimedia in learning is considered an important tool that helps students understand the material to achieve their learning goals. According to Amelia et al. (2021) and Syukrina (2017), the application of learning with multimedia with certain methods can increase the interest and understanding of students. According to Mayer (2022) and Zhu (2018), it is stated that making multimedia is the right solution to help students understand the material more easily. The solution to this problem is related to the devices owned by students and the advantages of multimedia, so it is important for multimedia development to be developed in the material of the circulatory system. In addition, multimedia can be used in the learning process by being made as attractive as possible.

Several other studies explain that the use of multimedia in teaching has proven to be a very effective learning tool. In addition, the results of the study confirmed that multimedia is useful in improving student learning achievement, as stated by Setyono (2016), as well as student learning achievement at the high school level, the application of multimedia in learning has been proven effective in increasing student

motivation and interest in the learning process, as found by Herlina (2014) and Osman et al. (2014) also found that the use of multimedia improves students' understanding and enthusiasm for learning. Therefore, in line with these statements, further research on the development of multimedia related to the material on the human circulatory system is important. This study is expected to improve student learning outcomes and enthusiasm in understanding the material on blood circulation using interactive learning multimedia.

Method

The research method used in the context of this research is development research, which is often referred to as Research and Development (R&D). This development research approach is an exploratory process carried out with the intention of creating, developing, and validating products that are relevant to the field of educational subjects. This research process combines aspects of scientific discovery and practical application, where the focus is not only on conceptual understanding but also on the development of products or innovations that can be applied in educational contexts. The development research stage consists of reviewing previous research on the product to be made, developing the product according to the manufacturing process, testing the product on users, and refining the product based on the findings. testing procedures as described in Borg and Gall (2003).

The development method applied in this study is the ADDIE Approach, as explained by Branch (2009). The stages are "Analysis, Design, Development, Implementation, and Evaluation". These phases are expressed in Indonesian. The development process always begins with this ADDIE model phase. The following is a more detailed explanation of the process of developing multimedia learning materials for human circulatory system biology with the ADDIE paradigm.

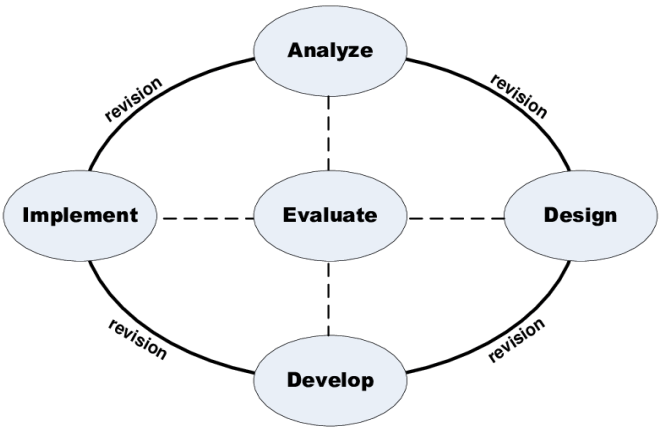

Figure 1. Stages of the ADDIE development model (Branch (2009)

Result and Discussion

The final product of this research and development is in the form of interactive multimedia that has been designed as a teaching medium for class XI students. The material presented in this curriculum covers aspects of biology related to the circulatory system. The development model used in this study is the ADDIE model: Analysis, this phase involves an initial survey that includes curriculum analysis, student characteristics, and learning needs, by implementing interviews and tests as analysis methods; Design, at this stage, the focus is on organizing and compiling the structural framework of the biology learning multimedia program using the Articulate Storyline 3 platform; Development, this stage includes the process of creating multimedia and alpha and beta testing to ensure the quality and effectiveness of the resulting product; Implementation, this step involves the application of biology learning multimedia for blood circulation material, which involves limited trials and class trials; Evaluation, at the evaluation stage, analysis is carried out to identify deficiencies and evaluate the efficacy of the product that has been developed, with the aim of making improvements and enhancements as needed (Sofyan, 2020; Reinbold, 2013; Branch, 2009).

The results of the product trial obtained will then be processed by researchers by describing the results of several data obtained at the product trial stage. Data obtained from the trial stage include alpha test data, beta test data and effectiveness test data. The three data were obtained through the research process that has been carried out, the following is an explanation of each data (Isaac & Michael, 1995).

Alpha Testing

Alpha testing on interactive biology learning multimedia products on the circulatory system material involves validation stages by experts. This validation process focuses on two main aspects, namely the media used and the biology material presented. Validation of media and materials is carried out using a questionnaire. Validation is carried out by two media experts and two material experts (Nadiyah & Faaizah, 2015, Jones & Richey, 2000).

Media Expert Validation Results

The first validator gave an average rating of 3.73 on a scale of 4, with the criteria of very feasible for the multimedia that had been developed. Meanwhile, the second validator gave an average rating of 3.55 on a scale of 4, with the criteria of very feasible as well. The first and second experts agreed that the product had reached a good standard and was suitable for use in learning.

However, both of them still provided input and suggestions that could be used as material for improvement and refinement. The suggestions and improvements that must be made include: a) The multimedia title is completed as Interactive Learning Multimedia, Human Blood Circulation System; b) Use text box colors that match the background; c) Buttons are changed to a more interactive form; d) Addition of instructions for using multimedia; e) Complete illustrations and pictures from the material; f) Summarize the writing on the material.

Results of Material Expert Validation

The first validator gave an average rating of 3.29 on a scale of 4, with the criteria of very feasible for the multimedia developed. Meanwhile, the second validator gave an average rating of 3.55 on a scale of 4, with the criteria of very feasible as well. The first and second experts agreed that the product had reached a good level of quality and was suitable for use in learning. However, both of them still provided input and suggestions as an effort to improve and perfect. The suggestions and improvements that must be made include: a) Replacing words that are still incorrectly typed; b) Addition and reduction of pages that still need improvement; c) Adding a summary page to each material; d) Adding sources to each image; e) Addition of bibliography; f) Addition of answer keys to assignment questions.

Beta Testing

Beta test result data were obtained from six respondents consisting of one teacher and five students of class XI MIPA. According to the assessment of biology subject teachers at SMAN 1 Sleman, this learning multimedia received a score of 3.47 on a scale of 4, with the criteria of very appropriate. The assessment of the first student (PD 1) showed an average score of 3.33 on a scale of 4, with the criteria of very appropriate. The second student (PD 2) gave an average score of 3 on a scale of 4, with the criteria of appropriate. Furthermore, the third student (PD 3) gave an average score of 3.20 on a scale of 4, with the criteria of very appropriate. The fourth student (PD 4) gave an average score of 3.93 on a scale of 4, with the criteria of very appropriate. Meanwhile, the fifth student (PD 5) gave an average score of 4 on a scale of 4, with the criteria of very appropriate.

Effectiveness Test Data

The research data consisted of pretest scores and student learning motivation scores, which were collected through questionnaires distributed at the beginning and end of the learning meeting. The results of the motivation questionnaire before showed a minimum score of 45 and a maximum of 72 with an average score of 55.8. The results of the motivation questionnaire after showed a minimum score of 53 and a maximum of 78 with an average score of 60.3. The average score showed an increase in the number from motivation before 55.8 to 60.3, this indicates an increase in student motivation after using the developed multimedia. This finding is consistent with the results of previous studies by Sharma et al. (2015), Irwanto et al. (2021), and Fauziyah (2020), which stated that the presence of multimedia in the learning process can improve learning conditions in the classroom and spur student motivation.

The pretest and posttest data of students during the use of interactive learning multimedia on the circulatory system were obtained as follows. The pretest scores varied between the lowest value of 13.3 and the highest of 93.3, with an average of 52.2. The posttest scores showed a range of values between 73.3 and 100, with an average reaching 95.8. There was an increase in value after using interactive learning multimedia on the circulatory system, from an average value of 52.2 to 95.8. The suitability of these results can be seen in the gain value of the initial and final test data which reached 0.91, included in the high criteria. This shows that interactive learning multimedia on the circulatory system for grade XI students at SMAN 1 Sleman has been proven effective, with a high level of effectiveness. This finding is in line with previous studies by Susiana et al. (2015), Satria et al. (2020), Melianti (2020), and Sundayana (2014), which show that the use of interactive learning multimedia has a significant positive impact on improving student learning outcomes. This success can be attributed to the ability of multimedia to present learning materials through various media.

Conclusion

The conclusion of this study shows that interactive learning about the human blood circulation system has been successfully developed using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model. The resulting multimedia product is declared very feasible to be used in the learning process based on the results of the alpha and beta tests. The assessment of the effectiveness of the learning multimedia shows an increase in student motivation and learning outcomes, where the average motivation score increased from 55.8 to 60.3, changing the motivation category from medium to high. The increase in learning outcomes is also seen from the increase in the average score from 52.2 to 95.8, with an N-gain value of 0.91 which shows a significant increase in the high category.

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This research contribution is the result of collaboration between students and advisors. The first author is a student, while the other is the author's advisor who has directed and guided the writing of this research until completion.

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