Development of Android-Based Interactive Multimedia on Mushroom Material in High School

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Abstract: This research aims to produce Android-based interactive multimedia products that are feasible to use, easy for students to learn, and assist students in learning and improve student learning outcomes independently. This type of development research used the Dick, Carey & Carey developer design model. The test subjects consisted of a study teacher, six expert validators, and thirty-two students of X grade. Sampling used a purposive sampling technique, by using consideration of student scores, which were divided into three namely, high, low, and medium categories. The instruments used involved trial questionnaires, test questions, and student response questionnaires. Each of which had been validated and analyzed with the content validity of Aiken's V ($V_{count} \geq V_{table}$). The research results show media expert validation with a score of 3.9 (valid and suitable for use), design expert validation with a score of 4.1 (very valid and highly suitable for use), and subject matter expert validation with a score of 4.1 (very valid and highly suitable for use). The results of individual test, small group test, and field test obtained an average result of 89.6% in the very positive category. Based on test performed by students, the results show that interactive multimedia development designs can be used to facilitate students to learn with an average percentage score of 85% (Very Positive Category). The feasibility of each of these processes shows that the Android-based interactive multimedia profile meets the requirements as a medium that can assist students in learning. The results of the effectiveness test also stated that interactive multimedia on Android-based had an effect and could improve students' cognitive learning outcomes with an N-Gain Score = 0.61 (Medium Category) and an Effect Size value = 2.322 (Category = Strong). The conclusion is based on the results of expert validation and product test, the Bio-Fungi learning application is feasible for use as a learning medium in the teaching and learning process and to improve students' cognitive learning outcomes.

Keywords: Android; Interactive multimedia; Mushrooms

Introduction

The quality of education of a nation is a very important to be addressed. This is because there is a correlation between the quality of education and the level of educational intelligence. In the school environment, the better the quality of education in a school, the better intelligence level of students within the scope of these students. Education is also able to make students capable of dealing with changes that occur, namely the development of the globalization era which leads students to the development of science and technology. Biology is one of the subjects studied at the high school level (Sari et al., 2021). This biology subject is included in the science and technology group which has the goal of obtaining competency on an ongoing basis and fostering a culture of scientific thinking creatively, critically, and independently (Nurhamidah et al., 2018). In improving these competencies, it is necessary to implement learner-centered learning (Safitri et al., 2019). The use of technology in the learning process aims to make it easier for students to solve

various learning problems, increase student learning motivation, foster students' ability to learn independently, and enable student learning interactions anywhere and anytime (Hartoyo et al., 2019). The role of technology used in learning activities has changed the teaching and learning process to become more interactive and student-centered as students directly interact with technology (Khalid et al., 2010). Learning must be able to provide real experiences for students. The learning process based on Constructivism learning theory is carried out to facilitate students in gaining learning experience about the way of knowledge is being studied (Astuti, 2019).

The development of technology that is currently developing rapidly is the use of smartphones (Hamimi et al., 2020). At this time of all the operating systems on smartphones, Android is the platform most frequently used by users (Nuri et al., 2021). This is because Android smartphones are easy to obtain at affordable prices and the quality is very supportive in using various types of applications (Firmansyah et al., 2022). Therefore, developments in using Android can be an opportunity to support activities in the world of education. One of them is developing learning applications that are expected to provide convenience for students in learning and increase student activity for participating in learning (Tabrani et al., 2021). To attract students' attention, learning applications are packaged in multimedia form which contains text material, pictures, learning videos and quizzes so that they can make learning more interactive (Hamdani et al., 2022). The main purpose of learning by employing interactive multimedia in learning is to enable students to study independently, review their lessons by reopening the application, and access the content from anywhere and anytime (Malik et al., 2012).

Learning is a planned activity that stimulates a person to be able to study well according to the learning objectives (Aunurrahman, 2014). Learning by using interactive multimedia on Android-based can provide students with learning experiences so that biology subjects whose material is abstract can become concrete by using the images and videos displayed. Through Android-based interactive multimedia, biology material can be visually presented, so thereby providing stimuli for various senses to interact with each other. This is reinforced by the existence of various kinds of visualizations displayed in android-based learning applications which make learning more memorable so that learning biology will be more easily remembered by the user's five senses (Siahaan et al., 2023).

The findings from the needs analysis, which involved unstructured interviews and a needs analysis questionnaire distributed to 72 students in the 11th grade at SMA Negeri 1 Kayan Hilir, revealed that 76% of the students identified mushroom topic as the most challenging material and identified the causes of their difficulties due to the complexity of the quantity of material, difficult to memorize, and the less fun material. Only 56% of students answered that 56% of the media had been used in biology lessons. The learning resources used so far used textbooks, students' worksheet *(LKS)* books, and power point in the form of illustrated slides. As many as 93% of students answered that they needed to develop new learning resources and learning media. Students are also enthusiastic about media consisting of videos, materials, and quizzes that can be accessed using an Android smartphone. This is also reinforced by the private facilities owned by students in the form of android smartphones as many as 94% of students and the quality of the school environment is also very supportive in implementing the use of android-based interactive multimedia in biology learning in the form of an adequate internet signal. The environment where students live also has an internet network so that students can study biology subject from anywhere and anytime, both at school and at home.

Responding to the results of previous observations, the development of Android-based interactive multimedia can also be used to maximize the use of Android smartphones because so far, students often use Android smartphones for hours to access social media and YouTube, but have not used them optimally to study, specifically biology material. By maximizing the use of learning media according to the needs of these students, it is expected that it can improve student learning outcomes. In previous research conducted by Nofitasari et al. (2021) about "My Biology App of Android-based in the digestive system material can improve students' motivation and learning outcomes. This further strengthens the researchers' development in learning application in the form of interactive multimedia on Android-based, specifically targeting different topics, such as the Fungi topic, to enhance the learning outcomes of X grade students in the Biology subject. This interactive multimedia is packaged into an Android application named Bio-Fungi.

Method

This development research was carried out at SMA Negeri 1 Kayan Hilir. The subject of this research involved students of X grade and the object of this research was an Android-based interactive multimedia in Biology subjects. The research method used the Dick, Carey and Carey learning development model (Dick et al., 2015). The steps used in this study are up to step 9. Based on the Dick and Carey model, the development steps can be obtained as shown in Figure 1.
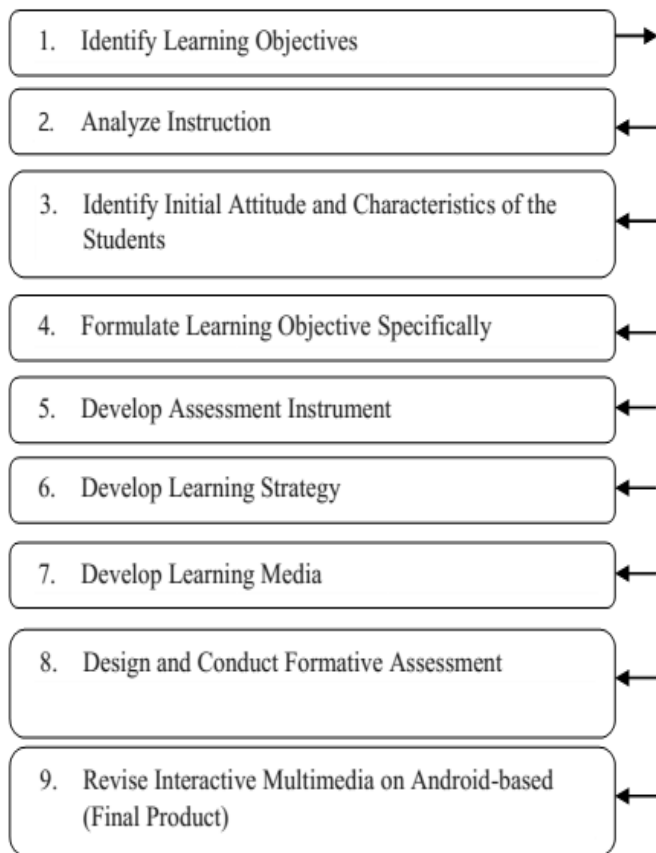
Figure 1. Dick and Carey development steps

The data collection instruments used interviews, expert validation questionnaires, product development test questionnaires, and student response questionnaires. The instruments before being used were analyzed first by two instrument experts and then analyzed with Aiken's V content validity.

The data assessment analysis technique used a quantitative descriptive and qualitative analysis techniques according to the type of data in this study. Qualitative data analysis was used to describe the research findings in the form of interview results as well as criticism and suggestions on the test of validation sheet regarding the application of Bio-Fungi. Quantitative data processing used a formula to calculate the percentage of acquisition results from expert validation questionnaires and test questionnaires. Analysis of Student Learning Outcomes is shapiro Wilk Normality Test (SPSS), Hypothesis Test (SPSS) and N-Gain Calculation.

Result and Discussion

Results
Development Design of Android-Based Interactive Multimedia
The results obtained in this stage are shown in Table 1.

Table 1. Data Analysis Results and Identification of Learning Objectives

Stages	Results
Needs Analysis (Material and Curriculum Analysis	The material selected by the researchers refers to material for which student scores are still low in the 2021/2022 academic year based on the results of observations, documentation, and needs analysis questionnaires.
Needs Analysis (Teaching Media)	Have never used Android-based learning, the media used so far is PowerPoint media.
Identify Cognitive Aspect Learning Objectives	There are 4 learning objectives in Fungi material.
Identify the Learning Objectives of Affective Aspects	Students are enthusiastic in learning Fungi material with the help of the Bio-Fungi application. Students are interested in using the Bio-Fungi application.

The results obtained in this stage are shown in Table 2.

Table 2. Instructional Analysis Result Data

Learning Objectives	Results of Identification of Learning Objectives
Skill Knowledge	Students can operate Android smartphones and can install applications and download learning materials.
Attitude	Students responded well to the Bio-Fungi application that was developed.

Table 3. Analysis of Students and Learning Environment

Learning Objectives	Identification Result of Learning Objectives
Basic Ability of Students	Students already have basic knowledge of Fungi material through learning material on the classification of living things at the junior high school level. Students can operate android smartphones.
Analyzing the Learning Environment from the Aspects of Learning Resources	The learning environment supports learning by using an Android smartphone and internet network.
Analyzing Student Learning Environment	Less active students in learning.

Formulating Specific Learning Objectives
The learning objectives set in this study are as follows. Through learning using interactive multimedia on Android-based students are able to: a) Describe the general characteristics of Fungi. b) Describe the grouping of Fungi based on their characteristics and ways of reproduction. c) Analyze the role of Fungi in life.

d) Analyze symbiosis in Fungi, both in mycorrhiza and in lichens.

The instruments developed by the researchers in this study were student response questionnaires and questions to measure students' cognitive learning outcomes. The results obtained in this stage are shown in Table 4.

Table 4 Analysis of Students and Learning Environment

Aspect	Results
Organizing Learning Content	Lesson Plan of Fungi Material
Learning Theory	Constructivist Theory
Approach	Scientific
Learning model	Cooperative Learning
Number of Meetings	2 Meetings

At this stage the researcher made a story board and then designed the initial draft into an application form before being validated by an expert validator. The initial product draft validation that has been developed involved six expert validators. The media expert validator consists of two experts with the results of the assessment in Table 5.

Table 5. Results of Media Expert 1 and Media Expert 2 Assessments

Aspect	Average Score	
	Media Expert 1	Media Expert 2
Utility	4.6	4.0
Function	4.2	3.4
Visual Communication	4.2	3.4
Average	4.3	3.6
Average Overall Aspects of Media Expert 1 and Media Expert 2		3.9

The design expert validator consists of two experts with the results of the assessment in Table 6 below.

Table 6. Results of Assessments Design Expert 1 and Design Expert 2

Aspect	Average Score	
	Design Expert 1	Design Expert 2
Characteristics of Learning Multimedia	4.5	4.5
Learning Activity Design	3.7	4.3
Learning Multimedia Stages	4.3	3.8
Design Implementation Assumptions	4.5	4.0
Learning Assessment Strategy	3.5	4.0
Average	4.1	4.1
Overall Average Aspects of Design Expert 1 and Design Expert 2		4.1

The material expert validator consists of two experts with the results of the assessment in Table 7.

Table 7. Results of Assessment Material Expert 1 and Material 2 Expert

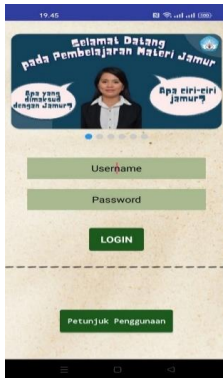| Aspect	Average Score	
	Material Expert 1	Material Expert 2
Content Eligibility Aspects	3.9	4.1
Presentation Feasibility Aspects	4.0	3.6
Aspects of Contextual Assessment	4.5	4.5
Average	4.1	4.1
Overall Average Aspects of Material Expert 1 and Material Expert 2		4.1

The average rating result obtained from the six validators is 4.0 (Category Valid) by following the suggestions and improvements from the experts. After the product has been revised and declared valid by an expert validator, the next step is to conduct product test consisting of individual test (three students), small group test (eight students), and field test (twenty-one students). The results of individual test, small group test, and field test are shown in Table 8.

Table 8. Results of Assessment Material Expert 1 and Material 2 Expert

Aspect	Average Score		
	Individual Trial	Small Group Test	Field Test
Media Engineering	77.8	88.6	92.4
Visual Communication	93.2	90.1	89.9
Learning	86.1	86.5	89.3
Average	89.2	89.2	90.3
Average of the Overall Trial Questionnaire			89.6

Based on Table 8, the average test results were obtained with a score of 89.6% (Very Positive Category) by following the suggestions and improvements obtained from students.

Table 9. Results of Revised Bio-Fungi Applications

Before Revision	After Revision	Information
		In the main display, a slider design is added, which is a sub-material of to be studied, there is also a login menu display and user manual buttons.

This revision was carried out referring to suggestions and comments provided by the six expert validators and comments/suggestions provided by

students in individual test, small group test, and field test. One of the results of the improvement obtained by the researcher is shown in Table 9.

Profile of Android Based Interactive Multimedia

The final result of the product in this development is an Android-based interactive multimedia on Fungi learning material for high school. Several parts of the developed Android-based interactive multimedia profile can be seen in Table 10.

Table 10. Profile of Android-Based Interactive Multimedia

Profile/ Display	Information
	The initial display contains a welcome slider and sub material, there is a login page and user manual buttons.
	Welcome display to learning Fungi material: on this page, there are basic competency buttons, profile buttons, and start learning buttons

The Effectiveness of Android-Based Interactive Multimedia Student Learning Outcomes

Student learning outcomes are obtained through student pre-test and post-test scores. Data analysis used the SPSS 27 application. The data normality test was tested using the Shapiro-Wilk normality test and the results obtained a significance level of 0.246 (pre-test) and 0.300 (post-test). This shows that the pre-test and post-test data are normally distributed (0.246 & 0.300) >

$\alpha = 0.05$. Based on the value of Sig. (2-Tailed) is 0.000 and less than 0.05. Thus, it can be concluded that there are significant differences in student learning outcomes after using interactive multimedia on Android-based on Fungi material. Based on the N-Gain Score calculation, it is known that the average student score is 0.61, which means it is in the range of $0.30 \leq$ N-Gain ≤ 0.70 in the "Medium" category. This means the use of Android-based interactive multimedia to improve student learning outcomes in the Moderate category. Based on the calculation of the effect size, it obtains a value of 2.322 so that the influence of Android-based interactive multimedia is classified as Strong (High). Thus, it can be concluded that the development of Android-based interactive multimedia can improve student learning outcomes.

Student Response

Response questionnaire distributed to students after using interactive multimedia on Android-based, the average student response score is 97.3%. Therefore, based on the response criteria for Android-based interactive multimedia, the product was stated to be very positive (very good).

Discussion
Development Design Android-Based Interactive Multimedia

The Dick, Carey and Carey model is a systematic learning design model and is suitable for use in educational development research. This model was selected on the basis of the consideration that this model was developed systematically and based on a theoretical foundation of learning design. This model is structured programmatically with systematic sequences of activities in an effort to solve learning problems related to learning resources that suit the needs and characteristics of students. Product design is a very important part that requires preparation so that the designed product gets good results as expected.

The results obtained from this development are interactive multimedia on Android-based. In the expert validation stage, an average result of 4.0 is obtained with a valid category, which means that the Bio-Fungi application is feasible to use in learning process. At the trial stage, an average result of 89.6% was obtained in the Very Positive category, which means that the Bio-Fungi application can be used for learning and obtains a very good response from students. The resulting Android-based interactive multimedia is in the form of a file with an application extension and is installed on an Android smartphone. In this research and development, the researchers develop a learning system that is used to develop learning that fosters student learning independence. This was also expressed by Hartoyo et al. (2019) namely by implementing Android-based

interactive multimedia in the learning process. It can be used as a visual and verbal expression in increasing student understanding of learning material.

Some of the advantages of Android-based interactive multimedia are in line with the following studies. Research by Conceicao et al. (2023) described the benefits of using interactive multimedia on Android-based, namely being able to attract students' attention so they don't feel bored and being able to help students who are left behind in environmental change material by learning independently. Research by Zakiyyatulmuna et al. (2022) also says that interactive multimedia on Android-based functions to clarify the delivery of learning material, overcome space and time limitations, and overcome student passivity. The benefits of Android-based interactive multimedia in learning were also expressed by Firmansyah et al. (2022) who stated that learning using Android-based interactive multimedia has several advantages, including: a) It can clarify the presentation of the material messages conveyed, b) Overcome limitations of space, time and senses, c) Can overcome the passive nature of students and d) Can provide the same experience and perception for students.

Profile of Android Based Interactive Multimedia

The end result of the product in this development research is an Android-based interactive multimedia. As revealed by Purnama et al. (2021) android can be used as a tool to support student learning independently because it can be used from anywhere and anytime. The creation of Android-based interactive multimedia utilizes the Kodular website whose results are exported in the form of an Android application. Through the Dick, Carey & Carey development design model, researchers have developed an application that is 13 megabytes in size and has the *apk* extension which means this application can be installed on an Android Smartphone. This application is named Bio-Fungi where the word Bio itself is taken from the name of the Biology subject and Fungi is taken from the Latin word which means Mushroom.

This application can also be sent via WhatsApp or Telegram as mentioned by Hafidz et al. (2018) that was choosing Android as the basis for making applications because to deploy and install these applications you do not have to go through the official application store from Android. The overall results of the research from media experts, design experts, material experts and students at each stage of the trial for each aspect show that they have fulfilled the eligibility requirements for Android-based interactive multimedia. Moreover, Android-based interactive multimedia profiles have fulfilled the requirements of a good media in line with the opinion of Asnawir et al. (2002) related to the requirements for

good learning media are: 1) The media used must be in line with the learning objectives that have been set, 2) Media learning is media that can be seen or heard, 3) learning media that is used can respond to student learning, 4) learning media that is used must be in accordance with the individual conditions of students, and 5) learning media is an intermediary in the student learning process. Thus, the Android-based interactive multimedia developed in this study is "feasible" to be used as a medium for learning biology in high schools. This is in line with the opinion by Kartini et al. (2020) which stated that multimedia in learning can be used for learning needs in achieving the effectiveness and efficiency of the learning process because beside being used as a communication tool, android can also be useful for students as interactive multimedia which can improve students motivation and increase student independence as well as improve students' ability to use technology in learning.

The Effectiveness of Android-Based Interactive Multimedia

To see the usefulness of the product being developed, it is necessary to measure the effectiveness of Android-based interactive multimedia. Efforts to assess learning outcomes are supported by opinions Setiawan (2017) which categorize learning outcomes into three groups, namely learning effectiveness, learning efficiency, and learning attractiveness. Android-based interactive multimedia is stated to be effective if it meets the requirements, namely an increase in student knowledge before using Android-based interactive multimedia and after using Android-based interactive multimedia. In line with what was expressed by (Haidah et al. (2022) that a learning product can be said to be effective if there is a change in values before and after using the learning product. Based on the results of the average student assessment before using Android-based interactive multimedia, it has reached 55.00, while the average student assessment results after using Android-based interactive multimedia reached 82.38. The effect size of calculation results show that the effect of Android-based interactive multimedia is relatively high, about 2.322. Thus, it can be concluded that the development of Android-based interactive multimedia can increase student knowledge. The results of this study are in line with research by (Sarah et al., 2020)which states that mobile learning is proven to be effective in significantly increasing learning outcomes in biology class X.

For the results of assessing student responses to the use of Android-based interactive multimedia, an average value of 97% was obtained in the very positive category. This is also in line with research by Kartini et al. (2020) where Android-based interactive multimedia produces positive responses from students during the

learning process. Interesting learning makes students happier and easier to absorb knowledge that can be seen from student responses during the learning process. Their responses mean social reactions in response to influences or stimuli from situations carried out by other people. Based on these things, it is necessary to develop interactive multimedia on Android-based to be able to facilitate student learning and the learning process in class.

Conclusion

Based on the formulation, objectives, results, and discussion of the research on the development of Android-based interactive multimedia on Fungi material in high school, it can be concluded that referring to the validation results of individual test, small group test, and field test on the development of Android-based interactive multimedia that is developed is included in the valid category (average score 4,0) and very positive (average 89,6%) so that it is acceptable and appropriate to be used as a medium in teaching and learning activities. Android-based interactive multimedia named Bio-Fungi is declared to have met the requirements and is feasible for use. The Bio-Fungi application consists of a Login Menu, Absent Menu, Developer Menu and Learning Menu (Basic Competence, Materials, Learning Videos, Video Tutorials, Quiz, Bio-Chat, and Evaluation). The effectiveness of Android-based interactive multimedia based on the results obtained is that there is a difference in average scores of students before and after using interactive multimedia on Android-based. As for students' responses to the use of interactive multimedia products on Android-based, it can be seen from how much the response of students before and after using its interactive multimedia. The researchers hope that through the Bio-Fungi application that has been developed, students are able to maximize its use as a learning resource and can help them to learn independently. It is also expected that the next teacher or researcher can develop this application with different material and concepts in the future so that this product can be even better.

Conflicts of Interest
The authors declare no conflict of interest.

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