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Designing an Android-Based Badminton Sports Introduction Learning Media

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ABSTRACT

Badminton is a popular sport in Indonesia and boasts a distinguished track record of international success. However, the introduction of this sport in elementary schools is often hampered by limited facilities and the delivery of theoretical materials. This condition results in students' low understanding of the rules and basic techniques of the game. Therefore, this study aims to develop an Android-based learning media that introduces badminton interactively by combining text, images, audio, video, and animation, thus making it easier for students to learn badminton. The research method used is the Multimedia Development Life Cycle (MDLC) with stages: Concept, Design, Material Collecting, Assembly, Testing, and Distribution. The application was tested using alpha and beta. The results of the alpha test showed that all features in the application ran as desired. Meanwhile, from the results of the System Usability Scale (SUS) test on this application, the total score obtained from 35 respondents was 2,582.5, which was then divided by 35, resulting in a final SUS score of 73.8. Based on the interpretation of the SUS score, the score is on a B grade scale, with a good rating and the application is suitable for use. This learning media application is expected to increase students' understanding and interest in badminton through a more interactive method and in accordance with current technological developments.

1. INTRODUCTION

Badminton is a sport played using rackets and shuttlecocks. It can be played by two people (singles) or four people (doubles) on a court. Badminton is also a very popular sport that is enjoyed by all segments of society, especially teenagers. This sport has its own appeal because it is fun to play. [1]. The introduction of badminton at the elementary school level is significant in fostering students' interest and developing their basic skills in this sport. [2].

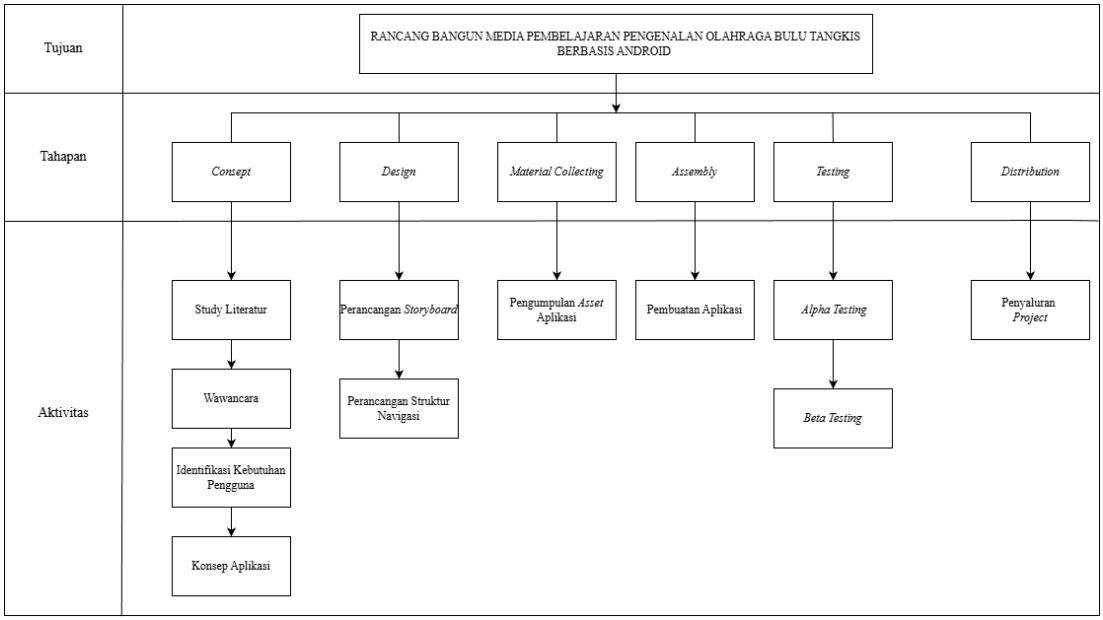
Based on interviews with physical education teachers at Jayaraga Elementary School in Tarogong Kidul District, obstacles were identified in badminton instruction. The majority of students had difficulty understanding the rules of the game and basic techniques due to limited facilities, such as a lack of rackets, shuttlecocks, or practice fields. This condition caused the learning process to focus solely on theory from textbooks, without direct practice, resulting in low student interest in learning.[3] Therefore, interactive Android-based learning media are needed that combine text, images, audio, and animation to make the material easier to understand and to attract students' attention. Several previous studies have developed game-based learning media and interactive multimedia. Research [4] developed a game application to introduce traditional sports, but the content focused solely on the long jump and did not cover other sports, such as badminton.

Research [5] showed that the use of Android-based learning media can improve students' understanding of basic mathematical operations, with a user satisfaction level of 87.4%. However, the study focused only on numerical subjects, not on physical education. Another study by [6] produced video tutorial-based learning media for basic volleyball techniques and demonstrated improved student skills. However, the development method was solely video-based and did not include interactive elements such as quizzes or animations. Furthermore, studies [7] and [8] also demonstrated that Android-based media effectively increased student understanding and motivation to learn. However, neither targeted sports content, specifically badminton, nor fully utilized the MDLC-based systematic approach.

Analysis of these studies shows that most of the developed learning media are still general in nature or focused on specific subjects such as mathematics, the environment, sign language, and sports other than badminton. Furthermore, some of the methods used have not effectively integrated interactive elements to support the understanding of sports techniques. Thus, there is a research gap regarding Android-based interactive learning media specifically designed to introduce and facilitate understanding of basic badminton techniques for elementary school students, particularly in schools with limited facilities and infrastructure. Based on the above explanation, this study aims to design and develop an Android-based learning media to introduce badminton to fifth-grade students at Jayaraga Elementary School, using the MDLC (Multimedia Development Life Cycle) method.

2. RESEARCH METHODOLOGY

This study uses the MDLC (Multimedia Development Life Cycle) method. The research flow is organized as a Work Breakdown Structure (WBS) to systematically describe the activities conducted during the research process. The WBS is shown in Figure 1. This method has six stages: concept, design, material collection, assembly, testing, and distribution. [9]. The stages of development are explained through the Work Breakdown Structure (WBS), which describes the objectives of the tasks and the implementation steps in accordance with the Multimedia Development Life Cycle (MDLC) methodology. Each action in this series of steps is described in detail in Picture 1.



Picture 1. Work Breakdown Structure Android-based badminton sports introduction learning media

This research follows a Work Breakdown Structure (WBS) consisting of several main stages. The first stage, namely Concept, involved defining the application's objectives and analyzing user needs through interviews with physical education teachers to identify problems in badminton instruction. However, this initial analysis was considered limited because it relied on a single data source. In this study, the needs identification process

was expanded through surveys and focus group discussions (FGDs) to better represent student preferences as the main users. Next, the Design stage focused on preparing the navigation structure, interface design, and feature mapping based on the results of user needs validation. The Multimedia Development Life Cycle (MDLC) method was chosen because it provides a systematic development flow and is more suitable for applications that integrate multimedia elements such as text, images, audio, and animation, and allows for a gradual evaluation process through alpha and beta testing compared to other methods such as ADDIE or R&D which are more oriented towards instructional design than the creation of interactive multimedia systems. Material Collection involves gathering multimedia assets such as images, text, audio, and animations, as well as materials relevant to the introduction, the sounds, and the basic rules of playing badminton. After that, in the Assembly stage, these materials are combined to build the desired application. Testing is carried out to ensure the quality of the application using alpha and beta testing methods, including black-box testing based on the application's functions. For beta testing, the SUS (System Usability Testing) method is used. Finally, the Distribution stage involves submitting the application via Google Drive, and the Google Drive link is then submitted to the Jayaraga Elementary School. Thus, the application development process involves systematic steps, from conception through distribution, to ensure the successful implementation and acceptance of the application by users.

3. RESULT AND DISCUSSION

The result of this study is an Android-based learning media application to introduce badminton as a learning tool for elementary school students. This application can display images and explanations for each image. The findings of this study include the following aspects:

3.1. *Concept*

This stage defines the scope of activities for the concept stage in accordance with the MDLC methodology. The activities carried out are:

1. Literature Study
   At this stage, activities are carried out through literature analysis in several journals with the aim of identifying the type of application, user objectives, and content to be implemented in the application development.
2. Interview
   At this stage, interviews were conducted at Jayaraga Elementary School to obtain information related to the research. It was found that many fifth-grade students still lacked understanding of the basic rules of badminton.
3. Identify User Needs
   At this stage of activity, the target users of the application are fifth-grade students at Jayaraga Elementary School
4. Application Concept
   Application Concept is the final activity in the concept stage, which involves formulating ideas and features to be implemented in the application. The application concept designed in this study includes:
   a. An interactive user interface, providing an attractive and easy-to-use display with clear navigation between application features.
   b. Quiz feature: provides several badminton questions to test and measure users' understanding of the material they have learned, while also making the learning process more interactive and enjoyable.
   c. Material features: provides several materials on badminton, such as the history of badminton in Indonesia, the equipment needed to play, and the rules.

3.2. *Design*

This activity involves creating a storyboard to illustrate the program's details. The design stage describes the specifications of the learning media for introducing badminton using a storyboard. According to Martin Luther,

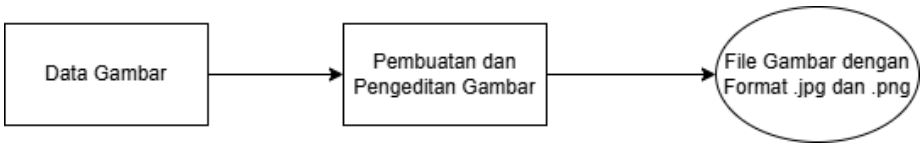
a storyboard is a description of each scene that aims to explain/illustrate multimedia objects and behaviors clearly [10]. In this section, the task is to describe the storyline of each activity that occurs in the application. The storyboard design for the application is shown in Table 2.

Table 1. Storyboard Design

No	Scene	Fill	Information
1	Scene 1	Loading screen	This page displays a loading screen featuring five photos of Indonesian badminton athletes who have won international tournaments. There is a loading bar with a duration of 8 seconds, after which the page automatically redirects to the Main Menu.
2	Scene 2	Main Menu Page	This page includes several menus that allow navigation to other pages or to the next scene. These menus include buttons for materials, quizzes, exit, about, settings, and sound.
3	Scene 3	Menu Materials	This page displays information about the history of badminton, the equipment needed to play, and the basic rules of the sport. It also features a "next" button and a "home" button to return to the main menu.
4	Scene 4	Quiz menu page	This page displays quiz questions about badminton, and includes a home button to return to the main menu.
5	Scene 5	Settings Menu Page	This page displays descriptions of the profiles of the supervisors and application developers, as well as icons of applications that support the creation of this learning media application. There is also a home button to return to the main menu page.

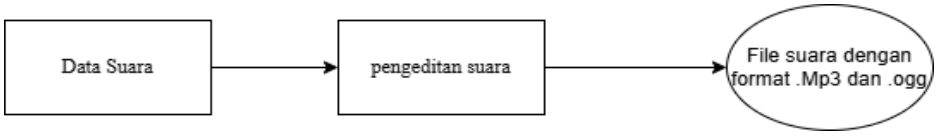
3.3 *Material Collecting*

When designing this learning media application, the necessary assets, including images, sounds, videos, and animations, are collected in advance at this stage and then processed at the integration stage. The methods for collecting materials and media are described below. At this stage in the image collection process, complete images, such as backgrounds, asset buttons, and hardware images, are generated in .jpg and .png formats tailored to the application concept. Some image materials are sourced from the internet and modified to meet the needs of the application being developed. The purpose of collecting image data is to obtain .jpg and .png files needed for the application development process, which will then be processed during the assembly stage.



Picture 2. Asset Collection Process Image

Next, audio data is collected to enhance the app's appeal. Audio files in .mp3 and .ogg formats are used to provide sound for each scene. The audio data is collected via internet downloads and then adapted for use in the assembly process. After the data is downloaded, the audio files are processed in the application that will be used during the assembly stage. The audio editing process required is shown in Figure 2.



Picture 3. Sound Asset Collection Process

Next is the collection of video data. Video files in .webm format are used as needed for application development. Some of the videos used were obtained from YouTube. After the videos are downloaded, they are processed in the application that will be used during the assembly phase. The video editing process required is shown in Figure 3.

Picture 4. Video Asset Collection Process

3.4 *Assembly*

At this stage, the author created the application based on the storyboard. All objects or materials were created and combined into a complete application [11]. The objective of this stage is to develop the application in accordance with the storyboard design and navigation structure developed in the design stage. The materials collected during the gathering process are used to assemble the application with Construct 2 as the development tool. The initial display page is shown in Picture 5.

Picture 5. Loading Screen

This page displays a loading screen that, when the application launches, shows 5 photos of Indonesian badminton athletes who have won several international championships.

Picture 6. Main Menu Display

Halaman This main menu page displays content with several buttons to access other pages, as shown in Picture 6.

Picture 7. Material Menu Display

This page explains the introductory material on badminton. Users can view the information displayed on the application, as shown in Picture 7.

Picture 8. Quiz Menu Display

This scene shows the quiz page, which displays questions about badminton. There are 20 questions, randomized each time the quiz starts. Only 10 questions are displayed, and each correct answer will add 10 points to the score. Incorrect answers will not reduce the quiz score, as shown in Picture 8.

Picture 9. Settings Menu Display

This scene displays the settings page, which includes the application creator's profile description and references, along with a back button to return to the home page. See Picture 9.

3.5 *Testing*

After the application is completed, a testing phase is conducted to ensure it runs smoothly and meets user requirements. [12]. The testing phase tests the application as a whole, both before and after use, using two tests: alpha testing and beta testing.

1. Alpha testing was conducted using the blackbox testing method. This testing activity included checking the appearance of each page, the functions of buttons, objects, and the sounds produced. The application was tested to ensure that all components functioned properly [13]. Based on the functional testing results, all processes from screen loading through the settings menu page were successfully executed, indicating that every feature in the application functions as expected and produces the correct output. A summary of the testing results is presented in Table 2.

Table 2. Alpha Testing

No	Test Class	Test Item	Description
1	Loading Page Display	Displays *Screen Loading*	Success
2	Main Page	Displays Main Page	Success
3	Material Menu Page	Displays Material Page	Success
4	Quiz Page	Displays Quiz Page	Success
5	Settings Page	Displays Settings Page	Success

2. Beta Testing is conducted in the field to assess an application's quality before it is used publicly. For beta testing, the SUS (System Usability System) method is used. The System Usability Scale (SUS) is a standard instrument for assessing the usability of digital products, particularly in interactive applications and learning media.[14]. Created by John Brooke in 1986, SUS offers a quick and safe method for calculating user experience using a questionnaire consisting of ten statements. Each statement in the questionnaire is evaluated using a five-point Likert scale [15].

Table 3. SUS Assessment Likert Scale

Satisfaction Level	Scale
Strongly Agree	5
Agree	4
Somewhat Agree	3
Disagree	2
Strongly Disagree	1

This test involved 10 respondents and aimed to assess the application's usefulness. Before completing the questionnaire, respondents were asked to try the game first. The questionnaire consisted of 10 questions.

Table 4. User Satisfaction Questionnaire

No	**Question**	**Code**
1	I think I will use this application often?	Q1
2	I think this learning media is easy to use?	Q2
3	I think this learning media is rather difficult to use?	Q3
4	I feel I need help from others to use this learning media?	Q4
5	I think all the menus and features in this learning media application are neatly arranged?	Q5
6	In my opinion, are there parts of this learning media application that are inconsistent or confusing?	Q6

No	Question	Code
7	In my opinion, can other people quickly understand how to use this learning media application?	Q7
8	In my opinion, is this learning media application confusing?	Q8
9	Do I feel confident when using this learning media application?	Q9
10	Do I feel that I need to learn a lot before I can use this learning media application?	Q10

Table 5. Shows the questions asked by researchers to users, with a total of 10 questions to test user satisfaction using a Likert scale of 1–5. shows the results of the user satisfaction questionnaire regarding the learning media application. The satisfaction results will be calculated.

Table 5. SUS Calculation Results

Skor hasil hitung										Jumlah	Nilai
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		(Jumlah x2,5)
4	1	4	3	4	1	4	3	4	4	32	80
4	2	4	2	4	1	4	2	4	3	30	75
3	3	4	3	4	3	1	0	4	0	25	62,5
4	0	4	0	4	0	4	4	4	1	25	62,5
3	2	2	1	2	3	3	3	3	3	25	62,5
4	3	3	3	3	3	2	3	3	3	30	75
3	4	3	4	3	4	4	4	4	1	34	85
3	3	4	4	4	2	4	3	3	1	31	77,5
3	3	3	2	3	4	3	3	3	2	29	72,5
4	3	4	3	4	3	4	4	4	2	35	87,5
4	3	4	3	4	4	4	4	4	1	35	87,5
4	1	4	3	4	1	4	3	4	4	32	80
3	3	3	3	3	3	3	3	4	2	30	75
4	4	4	4	4	4	4	2	4	1	35	87,5
4	3	3	3	3	3	3	3	3	3	31	77,5
4	1	4	1	4	1	4	1	4	4	27	70
3	3	3	2	3	4	3	3	3	2	29	72,5
3	4	3	4	3	4	4	4	4	1	34	85
2	2	2	2	2	3	4	4	4	4	29	72,5
4	4	4	4	4	4	4	1	2	2	33	82,5
2	2	2	4	4	4	3	3	3	4	31	77,5
1	4	4	3	4	3	4	3	4	4	30	75
4	3	3	2	2	2	4	4	4	4	32	80
3	4	4	3	4	4	2	1	4	4	33	82,5
3	3	3	3	3	3	3	3	3	2	29	72,5
4	3	4	3	4	3	4	3	4	3	35	87,5
2	3	2	2	3	2	4	4	4	4	30	75
4	4	4	4	3	3	3	4	4	2	35	87,5
3	3	3	4	4	4	1	4	4	2	30	75
4	1	4	1	4	1	4	1	3	4	27	67,5
3	3	3	2	1	4	2	4	4	4	30	75
4	4	4	4	4	4	4	1	2	2	33	82,5
3	2	1	4	4	4	4	4	4	4	34	85
2	1	4	1	2	4	4	4	4	4	30	75
4	3	2	4	1	4	2	3	3	4	30	75

Skor hasil hitung										Jumlah	Nilai
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		(Jumlah x2,5)
										Jumlah Skor Rata Rata	73,78

The System Usability Scale (SUS) test was administered to respondents via a link to the form. In this SUS test, 11 fifth-grade students acted as respondents by filling out 10 questions, each using a rating scale of 1–5, where a score of 1 indicated “strongly disagree” and a score of 5 indicated “strongly agree.” The collected data was then analyzed by separating the odd- and even-numbered questions. For odd-numbered questions (1, 3, 5, 7, 9), the contribution score was calculated using the formula answer – 1, while for even-numbered questions (2, 4, 6, 8, 10), the contribution score was obtained from the formula 5 – answer. All contribution scores from the 10 questions were summed, and the result was multiplied by 2.5 to obtain the final SUS score.

SUS testing is conducted by providing the examiner with a Google Form link. And in the System Usability Scale (SUS) testing, 25 5th-grade students, 11 teachers, and 4 guardians as test respondents filled out 10 questions with a score of 1-5 on each question, a value of 1 means strongly disagree, and a value of 5 means strongly agree. Then the score results that have been filled in by the examiner and calculated by separating odd and even questions, then Odd questions (1,3,5,7,9) Contribution score = Answer - 1, then even questions (2,4,6,8,10) Contribution score = 5 - Answer, then add up all contribution scores from 10 questions, multiply the result × 2.5 to get the SUS score.

SUS Score = ((P1-1) + (5-P2) + (P3-1) + (5-P4) + (P5-1) + (5-P6) + (P7-1) + (5-P8) + (P9-1) + (5-P10)) x 2,5

The SUS calculation was performed by applying a formula to each respondent's answer, and the results were then summed and multiplied by 2.5, according to the SUS calculation guidelines by John Brooke (1986) (Chairunnisa et al., 2024). The total score from 35 respondents was 2,582.5, which, after dividing by the number of respondents, resulted in a final SUS score of 73.78. Based on the standard interpretation, this score falls within the B (Good) category, so the application is considered feasible and easy to use. However, the results of this test focused more on functionality and usability, so they do not fully reflect the application's effectiveness in improving students' understanding of badminton material. Therefore, to strengthen the validity of the findings, a comparison of pre- and post-test results was conducted to assess students' understanding of the game rules and basic badminton techniques. The analysis results showed a 32% increase in understanding, as indicated by an increase in the average student score from 54.2 on the pre-test to 71.6 on the post-test after using the application. These findings indicate that the application is not only easy to use, but also contributes to increasing students' interest and understanding in learning badminton in accordance with the research objectives.

3.6 *Distribution*

Distribution is the stage where we provide access to users of the application we have created [16]. The distribution phase is carried out by granting end users access to the application. After the application is deemed feasible through testing, the.apk file is uploaded to Google Drive and shared with SDN Jayaraga for download and use. The test results show a SUS score of 73.78, which is in the B (Good) category, indicating that the application is easy to use and accepted by users. When compared with similar studies, such as the Android-based mathematics learning application by [5] with a satisfaction level of 87.4% and the video-based sports learning media by [6] with a feasibility score of 82%, the results of this study fall within a comparable range. This comparison shows that this application has a competitive level of usability and is relevant in the context of developing technology-based sports learning media.

4. CONCLUSION

The results of this study indicate that the Android-based educational media application for introducing badminton has been successfully developed. This application includes educational materials and interactive quizzes. The development process used the Multimedia Development Life Cycle (MDLC), which has proven effective for managing the application development cycle. Although the application has been successfully developed, there are limitations due to time constraints. Therefore, further research is recommended to add more comprehensive badminton learning materials, enrich interactive features, and increase the use of animation to prevent the application from appearing simplistic. Furthermore, this study has several limitations, including a small sample size, testing conducted at only one school, and a lack of comprehensive measures of knowledge improvement or direct learning impact. Therefore, further research is needed to evaluate learning effectiveness through methods such as pre- and post-tests on a broader scale, develop gamification elements to increase learning motivation, and integrate the application with the educational curriculum to make its implementation more relevant and sustainable in the school environment.

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