

Development of Multimedia-Based Interactive Learning Media to Improve the Understanding of Fifth Grade Students at Inpres Yubuwei Elementary School

Yuliati Padu Lemba^{1*}, Yustina Rada², Desy Asnath Sitaniapessy³

^{1,2,3} Informatics Study Program, Faculty of Science and Technology, Wira Wacana Christian University Sumba, Indonesia
yuliatipadulemba123@gmail.com^{1*}

Abstract

This study focuses on developing interactive multimedia learning media to improve the understanding of fifth-grade students at Inpres Yubuwei Elementary School in the subject IPAS, specifically the material on food chains. The media was developed using Unity 3D as an interactive application development platform, combined with the Model Development Life Cycle (MDLC) method to ensure a systematic and structured development process. To increase variety and challenge in learning, the Fisher-Yates Shuffle algorithm was applied to the quiz feature to randomize the order of questions. The application of this algorithm aims to avoid repetitive question patterns and encourage students to think more critically. The developed interactive learning media was then tested directly in a classroom environment. The test results showed a significant increase in student understanding, as indicated by a 71.6% increase in scores from the pre-test to the post-test. This improvement proves that the use of technology-based learning media that integrates interactive elements, games, and question randomization algorithms can effectively support the student learning process. Overall, this study shows that the combination of Unity 3D, the MDLC method, and the Fisher-Yates Shuffle algorithm has great potential in producing learning media that has a positive impact on elementary school students.

Keywords: Interactive Learning Media, IPAS, MDLC, Unity 3D, Fisher-Yates Shuffle Algorithm.

1. Introduction

Education is the foundation that forms the basis for character building and the development of children's thinking skills. At the elementary school level, students are introduced to various basic academic concepts and are guided to understand the moral and ethical values that will shape their personalities. In addition, basic education also plays a role in fostering curiosity, training critical and creative thinking, and building a sense of responsibility as preparation for facing challenges at higher levels of education. Thus, education has a significant role in creating a generation that is not only intellectually intelligent, but also has a strong character and is able to make a positive contribution to society [1]. In this era of information and communication technology (ICT) advancement, there have been major changes in the world of education, including at the elementary school level. One way ICT is used in learning is through multimedia integration, which can increase student engagement and help them understand difficult concepts [2]. Interactive multimedia learning media combines various elements such as text, images, videos, animations, and sounds, and allows users to interact directly with the material presented. This form of interaction can take the form of non-linear navigation, simulations, educational games, or quizzes with immediate feedback. In the world of education, interactive multimedia can be designed for various purposes, such as explaining material that is difficult to understand directly, providing a more engaging learning experience, and helping students develop skills relevant to the learning material [3].

Unity is a game engine developed by Unity Technologies Inc. that functions as an integrated development platform for building various interactive applications, such as games, simulations, and architectural visualizations. Unity supports application development on a variety of devices, including computers (PCs) and online-based applications. In web application development, Unity previously required an additional plugin called Unity Web Player, which was used similarly to Flash Player in web browsers. Unity is not designed as software for visual asset design or modelling. Therefore, the creation of graphic objects and visual elements is generally done using special design software, which is then imported into Unity for further development. In addition, Unity is an interactive application development engine that supports the use of the C# programming language as a scripting language. This platform is equipped with various supporting features, such as 3D object management, audio systems, animation, physics, and the ability to build on various platforms, making Unity one of the leading platforms in the development of games and educational multimedia applications. [4].

The Fisher-Yates algorithm, often referred to as the Knuth Shuffle, is a shuffling algorithm that has been proven effective and is widely used to randomly and evenly shuffle the order of elements in a list or set. The algorithm is named after its inventors, Ronald Fisher and Frank Yates, as well as Donald Knuth, who also contributed to its popularity. When implemented correctly, this algorithm ensures that every possible random order has an equal chance of being generated, making it an unbiased method. Many consider this algorithm to be a

reliable way to obtain truly random results from a data set [5]. The Fisher-Yates Shuffle algorithm is often considered the best way to generate accurate random sequences. In addition to providing truly random results, this method is also efficient in terms of time and memory usage, as illustrated in its workflow. In the context of quizzes, this algorithm ensures that questions do not appear in sequence, but are randomized, making the user experience more interesting and less boring [6]. The Fisher-Yates Shuffle algorithm begins shuffling data by setting the value N to a range from 1 to N . Next, a random number K is selected from the range 1 to N , with the condition that K cannot be 0 or greater than N . Then, the element at position K is swapped with the last element in the range 1 to N and placed separately. The value of N is updated to $N-1$. The shuffling process stops when N equals 0 [7].

SD Inpres Yubuwei is an educational institution located in Yubuwei Preparatory Village, Kahaungu Eti Subdistrict, East Sumba Regency. The school has nine teachers and consists of six classes. The research focused on fifth-grade students who were known to have difficulty explaining the subject matter in their own words, especially in Natural and Social Sciences (IPAS), with the title Harmony in the Ecosystem, particularly in the subject of Food Chains. When asked to convey their understanding, several students showed confusion and difficulty in rephrasing the words that had been conveyed, indicating that they had not fully assimilated the information provided. Based on initial observations, out of 16 fifth-grade students, seven scored below the minimum passing grade of 60, while the other nine scored above the minimum passing grade with scores ranging from 70 to 100. The teaching methods used by teachers are still conventional, such as one-way lectures, which are considered uninteresting and cause students to easily get bored because they are only passive listeners. This condition has an impact on low learning motivation and student involvement in the learning process. Meanwhile, the Merdeka Curriculum integrates science and social studies into IPAS (Natural and Social Sciences) with the aim of enabling students to understand the relationship between natural and social phenomena in an integrated manner. One of the subjects studied in IPAS in fifth grade is Harmony in Ecosystems, which discusses the relationships between living things, food chains, and ecosystem balance. This material is very important because it helps students understand the interrelationships between living things and their impact on the environment, thereby fostering awareness of the need to maintain the balance of nature. However, in reality, IPAS learning in elementary schools, including at SD Inpres Yubuwei, is still dominated by lectures and the use of textbooks. Students tend to be passive, only listening and memorizing information without being actively involved in the learning process. This results in students quickly becoming bored and less able to understand abstract concepts, including food chain material, which actually requires visual learning media to be more easily understood.

2. Research Methodology

The multimedia development life cycle (MDLC) was introduced by Luther Sutopo in 1994 and further developed by Ariesto Hadi Sutopo (2003). This model consists of six stages of multimedia development, namely: concept, design, material collecting, assembly, testing, and distribution. These six stages do not have to be sequential in practice; they can be interchanged. However, the concept stage must be the first to be worked on. Sutopo (2003) adapted and modified Luther's methodology with several adjustments, as shown in the following figure [8].

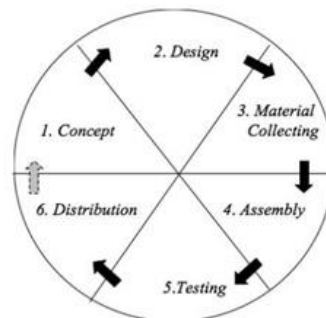


Fig. 1: Multimedia Development Life Cycle (MDLC)

1. **Concept**
This stage is the concept stage in the MDLC cycle. The first step is to set the objectives for creating the application and identify the users.
2. **Design**
The design stage is the process of designing the application to be developed. At this stage, specific and detailed requirements are compiled, including the project structure, user interface design, material requirements, and the visual style to be used.
3. **Material collecting**
Material collecting is the process of gathering all the materials needed to support the project's requirements. These materials can include images, photos, animations, videos, audio, and text, both existing and those that need to be adapted to suit the requirements.
4. **Production/Assembly**
The assembly stage is the process of compiling all multimedia materials into one. Application development at this stage refers to the results of previous designs, such as storyboards, wireframes, or prototypes.
5. **Testing**
Testing is a stage that aims to ensure that the developed multimedia application is in accordance with the established plan. This testing process can be carried out using either the black box or white box method
6. **Distribution**
Distribution is the final stage in the multimedia development process. This stage is carried out after the application is declared ready for use.

3. Results and Discussion

3.1. Learning Media Result

1. Opening Page

The home page is the first screen that appears when the application is launched. At this stage, a splash screen with the title “Food Chain Adventure” will appear. This page usually takes 3-5 seconds to load. After that, users are directed to the Title page, which displays a green landscape, a grasshopper character, and a yellow circular start button to launch the application.



Fig 1: Opening Page

2. Main Page

When users run the application, the main menu page displays four sub-menus consisting of: a materials menu as a learning tool, a quiz menu for practicing questions, a settings menu for adjusting the background music volume and sound effects, and an exit menu for closing the interactive learning media application.



Fig 2: Main Page

3. Material Page

The material menu page will display material about the food chain. The material displayed will be accompanied by images, text, and audio aimed at clarifying the explanation of the relationship between living things in the food chain. In addition, there is a back button that allows users to return to the main menu.



Fig 3: Material Page

4. Quiz Page

The quiz menu is equipped with a Home button that functions to return to the main menu and contains several questions related to the material that has been studied. In the application, the quiz menu contains 20 questions, each consisting of four answer choices. This quiz is divided into two levels, each containing 10 questions. The application will display questions along with supporting images and question texts. This page also displays the points earned and the time taken to complete the quiz. After the user has completed the entire quiz, the application will automatically display the final score and the duration of time taken to complete it. During the quiz, if the user answers correctly, a happy sound will be heard and the score will increase. Conversely, if the answer is incorrect, a sad sound will be heard, but the score will not change (neither decrease nor increase). Behind this quiz system, the Fisher-Yates shuffle algorithm is used to randomize the order of questions that appear so that they are not always the same each time the quiz is played.



Fig 4: Quiz Page

5. Score Page

After users complete the quiz in the quiz menu, the final score page will display the final results, where each question is worth 5 points. On this final score display, there are three buttons: the Home button to return to the main menu, the Start Again button that allows users to repeat the quiz, and the arrow button that functions to continue to the next quiz level.



Fig 5: Score Page

6. Exit Page

On this page, when the user presses the exit button, a confirmation message will appear saying “Are you sure you want to exit?” with two options, namely “OK” and “No”. If the user selects ‘OK’, the application will close and the user will exit the application. However, if the user selects “No”, the user will be returned to the main page.



Fig 6: Exit Page

a. Black Box Testing

Black box testing is a software functional testing method that focuses on the conformity between the functions, inputs, and outputs of an application with the specified specifications, without regard to the internal structure or program code. The application testing process is carried out comprehensively through manual and automated techniques, with the main focus on validating the main functions of the application [9]. Application testing using the black box testing method aims to ensure that all features in the application are functioning properly. Based on the test results, all features in the application are working as intended without any errors found in each display.

Table 1: Black Box Testing

The function being tested	Expected results	Test results	Result
Opening screen	Loading 3-5 seconds	Appears as expected	Succeed
Main menu	Displaying interactive learning material pages, quiz pages containing question level options, exit pages displaying a message asking if you are sure you want to exit? With OK and NO options, and settings pages displaying a pop-up for sound settings (music and sound effects).	shows that all features are working properly.	Succeed
Materials button	The material display appears	Appears as expected	Succeed
Home button	Return to the main page	Works well	Succeed
Quiz button	All text and options appear correctly	Works well	Succeed
Application of FYS Algorithm	The questions displayed will appear randomly, so they will not be the same in subsequent attempts.	Runs well	Succeed
Answer button	If the user answers correctly, the score will increase according to the value of each question and a pop-up notification will appear indicating the correct answer and moving on to the next question. Conversely, if the answer is incorrect, the score will remain the same and a pop-up will appear indicating the incorrect answer, then the system will automatically display the next question.	Working correctly	Succeed
Scoring and timing system	The score increases automatically and the time stops when all questions have been answered.	Running correctly	Succeed
Transition between levels	After completing the first 10 questions, users are directed to the next level.	Running well	Succeed
Back button (home)	direct users to the main menu.	Functioning well	Succeed
Scoring page	The final score appears	Displaying correctly	Succeed
Reset Button	The system repeats the quiz from the beginning and the score returns to 0.	Quiz repeating from the beginning	Succeed
Next Button	The system moves to the next level page	Functioning well	Succeed
Home Button	Return to the main page or previous menu	System returning to main menu	Succeed
Exit Button	A confirmation message appears with the text “Are you sure you want to exit?” and two buttons, ‘OK’ and “NO.”	The message appears as expected.	Succeed
OK Button	The application closes or exits the game	The application exits successfully.	Succeed
NO Button	The application cancels the exit and returns to the main menu.	The system returns to the main menu.	Succeed

b. Pre-test and Post-test

Pre-tests are given before learning to determine students' initial abilities, while post-tests are given after learning to measure students' understanding. A comparison of the two is used to assess improvement in abilities and the effectiveness of learning [10]. The results of both tests can be seen in table 2.

Table 2: Pre-test and Post-test

No	Student's Name	Value	
		Pre-test	Post-test
1.	Simeon Umbu Kabal	60	100
2.	Faldinan Tamu Ama	55	90
3.	Rambu Aya adriyanti Rohi	65	100
4.	Rikardo Kahar Jawa Ray	50	90
5.	Mikael Saputra Ama	60	100
6.	Sara Kornelia Rambu Hau	55	90
7.	Glen Pila Ndilu	65	100
8.	Rambu Dama Ana Hahar	45	90
9.	Bilkis Kahi Wahi	50	100
10.	Jilon Umbu Hunga	55	95
11.	Ignasius Umbu Mbadi	55	100
12.	Alvaro Kontino Tamu Ama	60	95
13.	Rin Tinggi Nalu	50	95
14.	Aninda Abigail Rawa	60	100
15.	Delon Rada Landu Wulang	55	100
16.	Putri Natalia Tamu Ina	60	100
Total Score		900	1.545

The results of the test conducted on 16 5th grade students of SD Inpres Yubuwai are shown in Table 2, which shows a total pre-test score of 900 and a total post-test score of 1,545. Next, calculations are carried out to determine the average pre-test and post-test scores. The average *pre-test* score is obtained as follows:

$$\bar{x}p_{re} = \frac{900}{16}$$

$$\bar{x}p_{re} = 56,25$$

The average score of the *post-test* was obtained as follows:

$$\bar{x}p_{ost} = \frac{1.545}{16}$$

$$\bar{x}p_{ost} = 96,5625$$

Based on the results of the calculation, the average *pre-test* and *post-test* scores were obtained, the average *pre-test* score was 56.25 and the average *post-test* score was 96.5625. The next stage is a percentage calculation to find out the magnitude of the increase in the score of 5th grade students of SD Inpres Yubuwai.

$$\text{Angka Persentase} = \frac{96,5625 - 56,25}{56,25} \times 100\%$$

$$\text{Angka Persentase} = \frac{40,3125}{56,25} \times 100\%$$

$$\text{Angka Persentase} = 71,6\%$$

Based on the calculation results, the average pre-test score was 56.25 and the post-test score was 96.5625. This shows an average increase of 71.6% after using the app. Thus, it can be concluded that the interactive learning media developed is able to help students in improving their learning abilities.

4. Conclusion

The results of the analysis were obtained through the process of creating an application. Testing using the blackbox method shows that all the features designed have worked according to their respective purposes and uses. Pre-test and post-test tests were carried out to measure the level of understanding of 5th grade students of SD Inpres Yubuwai towards food chain material in science subjects. Based on the calculation results, the average pre-test score was 56.25 and the average post-test score was 96.5625, with an increase of 71.6%. This percentage shows that the use of interactive learning media applications has succeeded in improving students' understanding of food chain materials with excellent results.

References

- [1] A. Yudianto, S. Pd, and M. Pd, *Pendidikan di Indonesia Interdisipliner Perspektif*. 2025.
- [2] W. N. Larosa, N. Amal, and J. Harefa, "E-LEARNING DI SEKOLAH DASAR : TANTANGAN DAN," vol. 02, pp. 21–26, 2025.
- [3] V. No *et al.*, "Penerapan Media Pembelajaran Interaktif Berbasis Multimedia Untuk Meningkatkan Pemahaman Konsep Matematika Peserta Didik Sekolah Dasar," vol. 2, no. 3, pp. 999–1003, 2024.
- [4] weliam jonatan mekel, S. R. . Sompie, and B. A. Sugiarto, "Jm_Informatika,+Jurnal+Wilyyy," *J. Tek. Inform.*, vol. 14, no. 4, pp. 455–464, 2019.
- [5] C. Y. Wardhana, P. Harsadi, and W. L. Y. Saptomo, "Implementasi Algoritma Fisher-Yates Shuffle Pada Game Edukasi Aksara Jawa Menggunakan Godot Engine," vol. 10, no. 1, 2022.
- [6] D. R. Fadilla, F. Fauziah, and R. T. Aldisa, "Pengenalan Bendera Negara Dengan Fisher Yates- Shuffle Pada Game Edukasi Android Menggunakan Metode GDLC," *J. Inf. Syst. Res.*, vol. 4, no. 4, pp. 1377–1386, 2023, doi: 10.47065/josh.v4i4.3754.
- [7] B. Subaeki and D. Ardiansyah, "Implementasi Algoritma Fisher-Yates Shuffle Pada Aplikasi Multimedia Interaktif Untuk Pembelajaran Tenses Bahasa Inggris," *Infotronik J. Teknol. Inf. dan Elektron.*, vol. 2, no. 1, pp. 67–74, 2017, doi: 10.32897/infotronik.2017.2.1.31.
- [8] A. Suryana, P. Pujiyono, K. Yuliyanti, and W. Walyono, "Pengembangan Media Pembelajaran Interaktif Pendidikan Agama Buddha Kelas Vi SD," *BAHUSACCA Pendidik. Dasar dan Manaj. Pendidik.*, vol. 1, no. 2, pp. 78–92, 2020, doi: 10.53565/bahusacca.v1i2.372.
- [9] W. N. Cholifah, Y. Yulianingsih, and S. M. Sagita, "Pengujian Black Box Testing pada Aplikasi Action & Strategy Berbasis Android dengan Teknologi Phonegap," *STRING (Satuan Tulisan Ris. dan Inov. Teknol.*, vol. 3, no. 2, p. 206, 2018, doi: 10.30998/string.v3i2.3048.
- [10] A. R. I. Ina Magdalena, Miftah Nurul Annisa, Gestiana Ragin, "Analisis Penggunaan Teknik Pre-test dan Post-test pada Mata Pelajaran Matematika dalam Keberhasilan Evaluasi Pembelajaran di SDN Bojong 04," vol. 3, pp. 150–165, 2021.