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# Development of an Educational Game for Introducing Object Names in English using the Multiplicative Random Number Generator Algorithm

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**Abstract**

The acceleration of technology has produced a substantial impact on the education sector, leading to the emergence of various teaching tools based on digital multimedia devices. However, the process of teaching English to first-grade students at SDN Wainggai, East Sumba, particularly for object recognition material, still heavily relies on traditional methods, namely oral instruction and the use of textbooks. This approach has caused students difficulty in memorizing vocabulary and requires a longer time for them to grasp the lesson, proven by their average score of only 67, which is below the school's Minimum Completeness Criteria (KKM 70). To overcome these learning barriers, this research proposes and develops an educational game that operates on the Android platform. Its primary goal is to support educators while simultaneously boosting students' motivation and vocabulary retention. The application presents objects with names in both English and Indonesian, and is designed as an interactive tool for first-grade students. The Multiplicative Random Number Generator (MRNG) algorithm is implemented to support the dynamic random features within the game. The expectation is that this educational game will foster a more enjoyable, engaging, and easily understandable English learning environment, ultimately optimizing students' learning outcomes and memorization skills.

***Keywords***: *Android, English Language, Educational Game, MRNG, SDN Wainggai*

## 1. Introduction

Technology shows an extremely rapid increase and has become an important part of modern life. This rapid advancement contributes greatly to various aspects, including advancing the education sector. The effect of technological development on education is strongly felt across various teaching levels. The utilization of technology encourages the creation of innovative teaching media, such as learning that integrates information through electronic, multimedia-based devices. These media have proven effective in stimulating the desire for independent learning, increasing creativity, and sharpening students' understanding. This situation is very beneficial for the world of education because continuously innovating media will greatly assist the student learning process.

SDN Wainggai, located in East Sumba, is an elementary school that incorporates English into the first-grade curriculum, including material for introducing objects in the surrounding environment. However, the teaching and learning process there is still limited to the use of books and verbal methods, without support from other media. This causes students to have difficulty memorizing vocabulary and requires a longer time to master the lesson.

To overcome these learning constraints, this research is focused on developing a learning game operated on the Android system. The purpose of this game is to assist teachers, facilitate vocabulary retention, and increase students' interest in learning. It is hoped that this game can make English learning more attractive (engaging) for children, thereby optimizing the delivery of the material. In its implementation, the game will use the Multiplicative Random Number Generator (MRNG) algorithm to generate random values. This algorithm works by calculating a series of seemingly random numbers and will be applied in the game's features. The ultimate goal is to create a fun, engaging, and easy-to-understand English learning atmosphere, especially for the students of SDN Wainggai.

# 2. Literature Review

## 2.1. Educational Games

Educational games are a type of game specifically designed with the primary focus of training thinking skills, improving concentration, and assisting players in solving specific problems or challenges. Their role in learning is crucial; educational games act as engaging tools for imparting knowledge or developing necessary skills. The learning process itself occurs effectively when players attempt to overcome the various obstacles presented in the game [1].

Overall, the goal of developing this type of game is to convey learning material, help students develop an understanding of a concept, practice various skills, and be a source of motivation for them [2]. By combining educational and entertainment elements, this game becomes an efficient learning medium. The content can vary, from school subjects, moral or religious teachings, to the introduction of new technologies.

## 2.2. Multiplicative Random Number Generator

The MRNG algorithm is a computational method that functions to generate a sequence of numbers that appear random, but are actually generated from complex mathematical calculations. Although the numbers appear random, the sequence of numbers is generated from a structured calculation process (not truly random). This concept was first introduced by D.H. Lehmer in 1951 [3].

$$Zi + 1 = (a \,.\, Zi + c) \,(\mathrm{mod}\ m) \quad (1)$$

This formula calculates a new random number (Zi + 1) based on the previous random number (Zi), using three key parameters:
1. Multiplier (a): Used to multiply the previous random number.
2. Increment (c): The incremental value added to the result of the multiplication.
3. Modulus (m): The maximum limit or divisor that determines the range of the generated random numbers.

## 2.3. English

English is recognized as the world's primary (global/universal) language, playing a crucial role in modern life. This language is vital because it makes it easier for us to communicate with people from other countries and disseminate knowledge [4]. Therefore, English language skills have become a basic skill that everyone must possess. This skill allows us to build and expand relationships (social networks) at an international level.

Recognizing its importance, there is a strong push for English to be taught from an early age. In today's era of globalization and technology, mastering English is becoming increasingly relevant and essential, especially for students. Although learning challenges sometimes arise due to inappropriate teaching methods, this need has been addressed by making English a subject taught starting in elementary school [5].

## 2.4. Multimedia

Multimedia is essentially a way to use computers to combine and present at least two digital materials simultaneously and in an engaging way. Essentially, multimedia is a mix of elements such as text (writing), sound, images, video, and animation. All of these elements are combined in an integrated way. The goal of this integration is to enable users to interact, search for information, create, and communicate easily through these various media [6, 7].

## 2.5. Android

Android is a mobile operating system developed based on the Linux kernel, specifically designed for touchscreen devices such as smartphones and tablets [8, 9]. Its main key is its nature as open source software, which means that its source code can be freely accessed, modified, and distributed by developers. This characteristic, coupled with extensive customization capabilities and strong integration with Google services, makes Android a popular open platform and the first choice for billions of users worldwide.

## 2.6. Unity

Unity is essentially a highly sophisticated game engine. Originally just an engine, it has now evolved into a complete integrated development environment (IDE) and a rapid development tool [10]. Unity's primary function is to provide all the basic code a game needs to run. This includes graphics, how objects move (physics simulation), lighting settings, and even camera functions.

Its main advantage is its cross-platform flexibility. This means you can create one game and then easily adapt it for a variety of devices—for example, from PC to Android or iOS. This flexibility greatly simplifies and lightens the workload for game developers [11].

# 3. Research Methodology

## 3.1. Research Design

This research uses the Waterfall development model (or Waterfall Model). This model's workings are highly structured and sequential; it's like creating a plan that must be followed step by step. The rules are clear: one stage must be fully completed before moving on to the next [12].

The main stages in the Waterfall method include five key steps:

1. Needs Analysis (Data Collection)
   This stage is about understanding what is truly needed from the game or system. This can be done by collecting data from surveys, observations, or interviews to ensure that the software developed truly meets user expectations.
2. Design
   This is the stage of creating a blueprint. We design the system architecture in detail, including how the data will be organized, what the interface will look like, and what algorithms will be used. The results serve as a guide for the implementation steps (coding).
3. Implementation (Coding)
   The approved design is then translated into program code. After coding is complete, each small part (module) of the game is immediately tested to ensure its functionality.
4. Testing
   In this stage, the game is thoroughly tested. We conduct user simulations to find and fix all errors (bugs). The goal is to ensure all features function perfectly as needed.
5. Maintenance
   This is the ongoing phase after the game is launched. This stage is crucial for adapting the software to changing user needs, fixing newly emerged bugs, and continuously improving performance to ensure the system remains relevant and usable for a long time.

### 3.2. Test Method

1. Black Box Testing
   Black Box Testing is a way to test the external functionality of software. We focus only on what the user can see and use, without needing to see or examine the underlying code [13]. The main focus is very simple: We ensure that every time we provide input, the system will produce the correct output, as expected. This testing is usually conducted at the end of the game development process to check the overall performance of the system.
2. Pre-test and Post-test
   These two tests are very important measurement tools in education [14].
   • A pre-test is a test given at the beginning before students are taught any material. Its purpose is to measure their basic understanding.
   • A post-test is a test given at the end of the learning process. Its purpose is to ensure students have mastered the material and to measure the effectiveness of the newly used learning program.
3. System Usability Scale (SUS)
   The SUS is a standard method used to measure how easy a game or system is to use (usability) and whether users are satisfied [15]. This tool uses only ten questions with answer choices ranging from 1 to 5. These questions are based on user experience and can be applied flexibly to various types of respondents.

## 4. Result

### 4.1 System Design

#### 1. Main Page


**Fig. 1:** Home Page

Upon opening the game, the main screen will appear, accompanied by background music. On this screen, you'll see four main navigation buttons: the "learn" button, which allows you to navigate through the material and learn the names of objects; the "game" button, which allows you to immediately start practice questions or play a game; the "about" button, which allows you to view information about the creator or developer of the game; and the "exit" button, which allows you to exit the application.

**2. Study Page**


**Fig. 2:** Learning Menu Page

When this educational game application is opened, users are greeted by a main screen featuring background music and four navigation buttons. These buttons are: the Learn button to access the object recognition material, the Game button to start practice questions, the About button containing information about the developer or researcher, and the Exit button to exit the application. The Learn menu presents a total of 40 vocabulary names of objects. Navigation in this material menu is made simple, with a Home button in the top left that allows users to return to the main menu, and the right and left arrow buttons to switch between the next and previous materials.

**3. Play Yard**


**Fig. 3:** Play Menu Page

In the Game menu, you'll be asked to choose one answer from four available options. Each time a new question is presented, the positions of the four answers are randomized, so guessing based on position is impossible. After selecting, the system will immediately notify you whether your answer is correct or incorrect (feedback). For navigation, players can see their score (which increases for correct answers) in the upper right corner, while in the upper left corner, there's a Home button and a running timer.

4. **About Page**


**Fig. 4:** About Page View

This page only serves to display information about the game creator, i.e., the researcher or developer. Details provided include name, university of origin, and major.

**5. Score Page**


**Fig. 5:** Score Page View

After you're done playing, a page will appear displaying your total score, clearly titled 'Your Score'. At the bottom of the screen, there are two navigation buttons: Home: To return to the main menu of the app. Replay: To start the game over again.

## 4.2 System Testing

### 1. Black Box Testing

Conducting black box testing to verify that all game features are functioning as intended. Based on testing conducted on all parts of the application—the main menu, learning menu, play menu (quizzes), and the About page—all functions were confirmed to be working properly and successfully without any issues.

**Table. 1:** Black Box Testing

| Test name | Expected results | Result | |
|---|---|---|---|
| | | Succeed | Fail |
| Main Page | The Main Menu Display appears | √ | |
| Study Page | The Learning Menu Display appears | √ | |
| Play Yard | The Play Menu Display appears | √ | |
| About Page | The About Menu Display appears | √ | |
| Score Page | The Score Menu Display appears | √ | |

## 2. System Usability Scale

To test the level of ease of use (usability) of the system, five respondents (users) will be involved, consisting of the Principal and four Teachers from SDN Wainggai.

**Table. 2**: Principal and Teacher Respondents

| Respondents | Name | Status |
|---|---|---|
| R1 | Ngabi Kahewamarak S.Pd., SD | Kepala Sekolah |
| R2 | Mariana Nd. Tamar S.Pd., Gr | Guru |
| R3 | Damaris R. Ngana S.Pd | Guru B. Inggris |
| R4 | Ofliana Radja S.Pd., Gr | Guru |
| R5 | Marlin T. Mbitu S.Pd | Guru |

**Table. 3:** Pengujian SUS

| Respondents | SUS Statement | | | | | | | | | | Total | SUS Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | | |
| R1 | 4 | 3 | 4 | 1 | 5 | 2 | 4 | 2 | 4 | 2 | 31 | 77,5 |
| R2 | 4 | 2 | 5 | 2 | 5 | 2 | 4 | 2 | 4 | 3 | 33 | 82,5 |

| | | | |
|---|---|---|---|
| R3 | 5 3 4 2 5 3 4 1 5 2 | 34 | 85 |
| R4 | 4 3 4 1 4 2 4 1 4 3 | 30 | 75 |
| R5 | 4 2 4 2 4 3 4 2 4 3 | 32 | 80 |
| | **Total** | | **400** |

After testing this application using the SUS method (to measure ease of use), the five respondents (Principals and teachers) gave a total overall score of 400. From this total score, calculations will then be carried out to obtain the average SUS score.

$$x = \frac{400}{5} = 80$$

After all calculations were completed, the average SUS score was 80. This score represents a very satisfactory result. Compared to the SUS assessment standard, a score of 80 places this educational game in the "Excellent" category. This also means the app falls within the acceptable range for use.

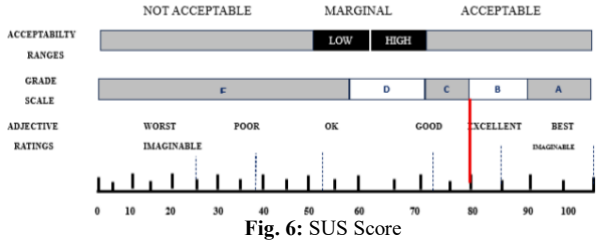


**Fig. 6:** SUS Score

**1. Pre-test and Post-test**

This study involved 20 students from Grade 1 as subjects. To see the differences in student scores from the pre-test and post-test, a detailed comparison can be found in Table 4.

**Table. 4**: Pre-test and Post-test

| Number | Name | Pre-test | Post-test |
|---|---|---|---|
| 1. | Celsia | 27,5 | 65 |
| 2. | Betseba | 32,5 | 70 |
| 3. | Renata | 35 | 70 |
| 4. | Maeselina | 35 | 87,5 |
| 5. | Deasmara | 27,5 | 70 |
| 6. | Eka | 40 | 90 |
| 7. | Friski | 42,5 | 90 |
| 8. | Anjelita | 35 | 85 |
| 9. | Felisia | 40 | 85 |
| 10. | Trisia | 35 | 85 |
| 11. | Rosa | 40 | 85 |
| 12. | Dedi | 40 | 87,5 |
| 13. | Rafael | 40 | 90 |
| 14. | Fekiel | 50 | 100 |
| 15. | Andika | 35 | 82,5 |
| 16. | Novantro | 35 | 75 |
| 17. | Jois | 40 | 87,5 |
| 18. | Andika Setiawan | 40 | 87,5 |
| 19. | Sirene | 35 | 85 |
| 20. | Ernasari | 42,5 | 82,5 |
| | Total | 752,5 | 1.660 |

## 5. Conclusion

The results of the entire process (analysis, design, and testing) concluded that the development of this Android-based English educational game proved to be very effective in improving the ability of 1st grade students of Wainggai Elementary School to master the vocabulary of object recognition material. Application validation was carried out through two types of testing: First, Black Box Testing confirmed that all features in the game functioned optimally and in accordance with the planned design. Second, Pre-test and Post-test conducted on 20 students showed a real increase in understanding regarding the recognition of object names in English. This increase was supported by a very significant jump in the average score, namely from 37.62 in the initial test (pre-test) to 83 in the final test (post-test). Therefore, this educational game is considered successful and worthy of being implemented as a learning medium for 1st grade students.Further Development: The researchers recommend that this study be continued and pursued into further development. Key suggestions for future research include the integration of Mixed Augmented Reality to maximize the user's interactive experience. Furthermore, it is

recommended to test the implementation of other algorithms beyond those already present in the game structure to explore gameplay efficiency and variety. Finally, it is recommended to include other English language learning materials so that the game can encompass broader and more comprehensive learning aspects.

## References


[1] Afrianto, I., & Furqon, R. M. (2018). The Herbalist Game Edukasi Pengobatan Herbal Berbasis Android. *Jurnal Sistem Informasi Bisnis*, *8*(2), 141

[2] Diharjo, W. (2020). Game Edukasi Bahasa Indonesia Menggunakan Metode Fisher Yates Shuffle Pada Genre Puzzle Game. *INTEGER: Journal of Information Technology*, *5*(2).

[3] Dinata, R. K., Fikry, M., & Tahir, H. (2018). Implementasi Algoritma Multiplicative Congruential Random Number Generator Pada Try-Out Smp (Sekolah Menengah Pertama) Berbasis Client Server. *Techsi-Jurnal Teknik Informatika*, *10*(1), 129-140.

[4] Khairani, A. I. (2016). Pendidikan Bahasa Inggris untuk Anak Usia Dini. *Digital Repository Universitas Negeri Medan*. Diunduh dari http://digilib.unimed.ac.id/id/eprint/448/

[5] Reza, D. (2009). Asyik Bermain dan Belajar Bahasa Inggris. *Jakarta: Agro Media Pustaka*.

[6] Irawan, Y., Wahyuni, R., & Herianto, H. (2019). Media Pembelajaran Bahasa Inggris Dasar Menggunakan Macromedia Flash 8 Di TKKartika 1.50 Kecamatan Sail Kota Pekanbaru. Informatika, 11(2), 1-7.

[7] Leong, M. Mulyanta.(2009). *Tutorial Membangun Multimedia Interaktif-Media Pembelajaran. Yogyakarta: Universitas Atma Jaya*.

[8] Nazarudin, S. H., Smartphone, P. A. M., & Tablet, P. C. (2012). berbasis Android. *Badung: Informatika*.

[9] Hermawan, K., Iskandar, A. A., & Hartono, R. N. (2011, November). Development of ECG signal interpretation software on Android 2.2. In *2011 2nd International Conference on Instrumentation, Communications, Information Technology, and Biomedical Engineering* (pp. 259-264). IEEE.

[10] Sinicki, A. (2019). Unity Untuk Pengembangan Game Android Sebuah Paduan Lengkap Untuk Desain, Pengembangan Hingga Pemasaran Game. ed. *Giovanny Rizki. Yogyakarta: Andi*.

[11] Creighton, R. H. (2011). *Unity 3: Beginner's Guide; a Seat of Your Pants Manual for Building Fun, Groovy Little Games Quickly with Unity 3*. Packt Pub..

[12] Sommerville, I. (2011). *Software Engineering, 9th Edition*. Addison-Wesley.

[13] Cholifah, W. N., Yulianingsih, Y., & Sagita, S. M. (2018). Pengujian black box testing pada aplikasi action & strategy berbasis android dengan teknologi phonegap. *STRING (Satuan Tulisan Riset dan Inovasi Teknologi)*, *3*(2), 206-210.

[14] Aqmarani, A., Magdalena, I., & Ayudhiya, N. (2021). Evaluasi pembelajaran pada tingkat sekolah dasar. *Cerdika: Jurnal Ilmiah Indonesia*, *1*(2), 57-63.

[15] Ependi, U., Kurniawan, T. B., & Panjaitan, F. (2019). System usability scale vs heuristic evaluation: a review. *Jurnal Simetris*, *10*(1), 65-74.