Design of English Language Educational Game for Elementary School Students Using ADDIE Approach

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Abstract
This study aims to develop a desktop-based English language educational game as a learning aid for fourth-grade elementary school students. Game-based media development was chosen because game-based learning can increase student engagement and is widely used to support English learning for children, especially in vocabulary aspects. This study uses the ADDIE model consisting of the stages of analysis, design, development, implementation, and evaluation, because this model is widely used for systematic development of learning media. The game was developed using Unity with the C# programming language and can be run offline on school laboratory computers. The material and questions are arranged based on the 4th grade English teaching module of the Merdeka Curriculum, while the book 'My Next Words Grade 4' is used as a supporting learning resource. The game consists of 12 levels and 120 questions with multiple choice, true/false, sentence construction, and finding incorrect word models. The product evaluation was conducted through teacher validation, Black Box Testing, and User Acceptance Test. The user acceptance evaluation involved 28 fourth-grade students of SD Negeri 2 Ngemplak, Sleman, Yogyakarta as participants. The User Acceptance Test result obtained a percentage of 83,93%, which was categorized as excellent.

Keywords— *education game, english, desktop, junior school, unity*

1. INTRODUCTION

English learning at the elementary school level must consider the characteristics of students who are still in the concrete learning stage. At this stage, students more easily grasp material when learning is delivered with the help of visuals, audio, simple examples, and activities that involve interaction. In English Learning Outcomes Phase B, students are directed to master commonly used vocabulary in everyday life with the help of pictures or illustrations, and can respond to simple short texts in written, visual, multimodal, or interactive formats [1]. This shows that English learning media should not only provide material in text format, but should also include visual, audio, and interactive elements.

Vocabulary is a crucial element in learning English because it serves as the foundation for students to understand the meaning of words, simple sentences, and basic communication contexts. Vocabulary mastery in elementary school children must be supported by media that is appropriate to their learning style. Previous research has shown that the use of games in English learning is widely applied to young learners, especially to aid vocabulary mastery [2]. Thus, educational games can be a learning media option that allows students to learn through more engaging and participatory activities.

Learning games are tools that integrate game elements with teaching purposes. Through educational games, content can be presented in the form of challenges, points, images, audio, and direct responses. Research conducted by Arisanti and Zuhdi revealed that the Android-based educational game VOCALISH is considered valid, practical, and effective in improving English vocabulary mastery of fourth-grade elementary school students [3]. Research related to

educational game development was also conducted by Dwiyanto and Irianto who developed an Android-based picture guessing game to improve the cognitive function of the elderly. The study used the ADDIE method, Black Box Testing, and User Acceptance Testing to ensure the feasibility and user acceptance of the developed game [4]. In addition, Sasongko et al. developed a crossword puzzle game as a supporting medium for elementary school science learning using the Game Development Life Cycle method. The results of the study showed that the game can be used as a supporting medium for learning because it obtained a System Usability Scale feasibility score of 87.38 with an excellent category [5].

Another study by Wibowo and Irianto developed an Android-based word guessing game using the ADDIE, Unity, Black Box Testing, and User Acceptance Testing methods with a UAT result of 79% in the satisfactory category [6]. Maulana and Junianto's study also showed that Android-based English educational games with the ADDIE model can be used as an alternative medium in English learning [7]. These findings indicate that educational games can play a role in supporting English learning for elementary school students. Several studies have shown that games can be developed as interactive supporting media and can be evaluated through functional testing and user acceptance.

However, not all schools have the conditions to support the use of Android devices or personal smartphones in learning activities. Based on the needs analysis in this study, the school has computer lab facilities available for student use, but the use of personal smartphones is not permitted during learning. Therefore, this study developed a desktop-based English language educational game that can be run offline on school computers. The choice of an offline desktop platform was made so that the learning media could be used according to school facilities and not depend on an internet connection.

This research focuses on the development of an English educational game for fourth-grade students of SD N 2 Ngemplak, Sleman, Yogyakarta, Indonesia. The material and questions in the game are arranged based on the 4th-grade English teaching module of the Merdeka Curriculum. The teaching module is used as a reference in determining learning objectives, materials, and question mapping, while the My Next Words Grade 4 book is used as a supporting learning resource listed in the teaching module [8], [9]. Thus, the questions in the game are arranged based on learning needs, not only based on the game design. This game was developed as a learning aid, not as a substitute for the role of the teacher.

Based on the description, this study aims to develop a desktop-based English educational game as a learning aid for fourth-grade students of SD N 2 Ngemplak, Sleman, Yogyakarta, Indonesia. Testing was conducted through question validation by teachers, functional testing using Black Box Testing, and User Acceptance Test to determine the level of student acceptance of the game developed by involving 28 fourth-grade students of SD N 2 Ngemplak, Sleman, Yogyakarta as participants.

2. METHODS

This research is a development research that produces a product in the form of a desktop-based English language educational game. The development method used is ADDIE, which consists of five stages: analysis, design, development, implementation, and evaluation. The ADDIE model is used because it has a systematic flow in developing learning media, starting from identifying needs to product evaluation [7].

2.1 Needs Analysis

The analysis phase was conducted to identify user needs, student characteristics, school facilities, and English learning materials for fourth-grade students at SD N 2 Ngemplak, Sleman, Yogyakarta. The analysis revealed that the school has a computer lab that can be utilized as a digital learning tool. Furthermore, students are not permitted to use personal

smartphones during learning activities. This situation provided the basis for developing a desktop-based game that can be played offline.

Material analysis was conducted by referring to the Grade 4 English language learning module of the Independent Curriculum. The learning module was used as a basis for determining learning objectives, mapping material, and the suitability of questions to the abilities of Grade 4 elementary school students. The book My Next Words Grade 4 was used as a supporting learning resource because it is included in the learning module as reading material for teachers and students [8], [9].

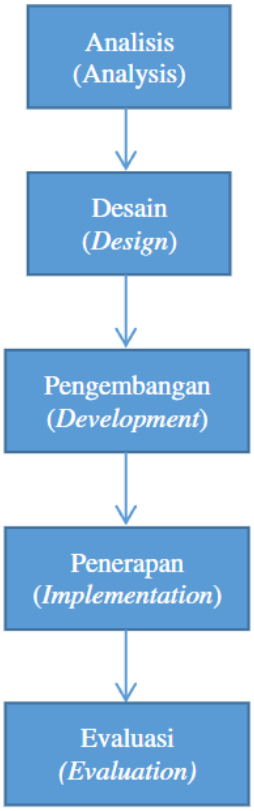

Figure 1. Development of the ADDIE Model

2.2 Game Design

The design phase involved developing the game concept, gameplay, level structure, question model, interface design, and audio design. The game was designed to have 12 levels, each containing 10 questions. A total of 120 questions were used in the game. Each level was mapped based on a unit in the English teaching module for grade 4 at SD N 2 Ngemplak, Sleman, Yogyakarta.

The test models used include multiple-choice, true/false, arrange the sentence, and find the incorrect word. The multiple-choice and true/false models are used to practice vocabulary comprehension and simple statements. The arrange the sentence model is used to practice understanding word order in English sentences. The find the incorrect word model is used to help students recognize errors in simple sentences.

2.3 Game Development

The development stage was carried out using Unity with the C# programming language. Unity was used because it supports the creation of 2D and 3D games, and provides features for managing objects, interfaces, animations, scenes, and audio [10]. The game developed consists

of the Main menu, About, Settings, Exit, Menu Level, question pages, and results pages. The use of Unity in game development was also used in Wibowo and Irianto's research, namely in the development of an Android-based word guessing game [6]. This shows that Unity can be used to develop educational games with interface, audio, and user interaction features.

The game also features BGM, SFX, and pronunciation audio. BGM is used as background music during gameplay. SFX is used as sound effects when students answer correctly or incorrectly. Pronunciation audio is used to read out questions and correct answers. Audio management is done through the Audio Source component in Unity, which supports automatic audio playback through the Play On Awake feature and repeated playback through the Loop feature [11].

2.4 Game Implementation

The implementation phase involved piloting the game with fourth-grade students at SD N 2 Ngemplak, Sleman, Yogyakarta, in the school's computer lab. Students tried the game directly using the available computers. The game runs offline, so it doesn't require an internet connection. After trying the game, students completed a User Acceptance Test to assess the game's ease of use, display, audio, question clarity, and usefulness as a learning aid.

2.5 Evaluation

The evaluation was conducted through three stages, namely question validation by the teacher, Black Box Testing, and User Acceptance Test. Question validation was conducted by the 4th grade homeroom teacher of SD N 2 Ngemplak, Sleman, Yogyakarta to assess the suitability of the questions to the teaching module, learning objectives, the accuracy of the answer key, the level of difficulty, and student abilities. Black Box Testing was used to test the game's function based on pages, input, process, output, and validity. User Acceptance Test was used to determine the level of student acceptance of the developed game, especially from the aspects of ease of use, appearance, audio, questions, and the benefits of learning media [12]. The use of Black Box Testing and User Acceptance Test in game evaluation was also used in Dwiyanto and Irianto's research, namely, to ensure the game's functionality and to determine user acceptance of the developed product [4].

The UAT calculation formula is shown in equation (1).

$$Percentage = \frac{Total\ Score\ Obtained}{Maximum\ Score} \times 100\% \quad (1)$$

The user acceptance testing (UAT) result category criteria can be seen in table 1.

Table 1. UAT Result Category Criteria

Percentage	**Category**
81% - 100%	Excellent
61% - 80%	Very good
41% - 60%	Good
21% - 40%	Average
0% - 20%	Poor

3. RESULT AND DISCUSSION

3.1 Game Development Results

The result of this research is a desktop-based English educational game that can be played offline. The game was developed as a learning aid for fourth-grade elementary school students. The final product consists of 12 levels with a total of 120 questions. Each level contains 10 questions arranged according to units in the fourth-grade English teaching module of the Merdeka Curriculum.

The game's content covers daily activities, numbers 50 to 100, rooms and prepositions, activities at home, objects in rooms, objects in the kitchen and bathroom, the use of cans, time, daily activities, adverbs of frequency, transportation, and the use of vehicles in daily activities. The material is aligned with the learning units in the teaching module and is supported by the My Next Words Grade 4 book as a learning resource [8], [9].

The game has several main features: the main menu page, level menu, game instructions, question page, scoring system, results page, sound settings, BGM, SFX, and pronunciation audio. The main menu page contains the Play, About, Settings, and Exit buttons. The level menu page is used to select the game level. The question page is used to display questions according to the selected level. The results page is used to display the final score after students complete the questions.

Figure 2. Page of Main Menu

Figure 3. Page of Menu Level

Figure 4. Multiple Chioce Question

Figure 5. True/False Question

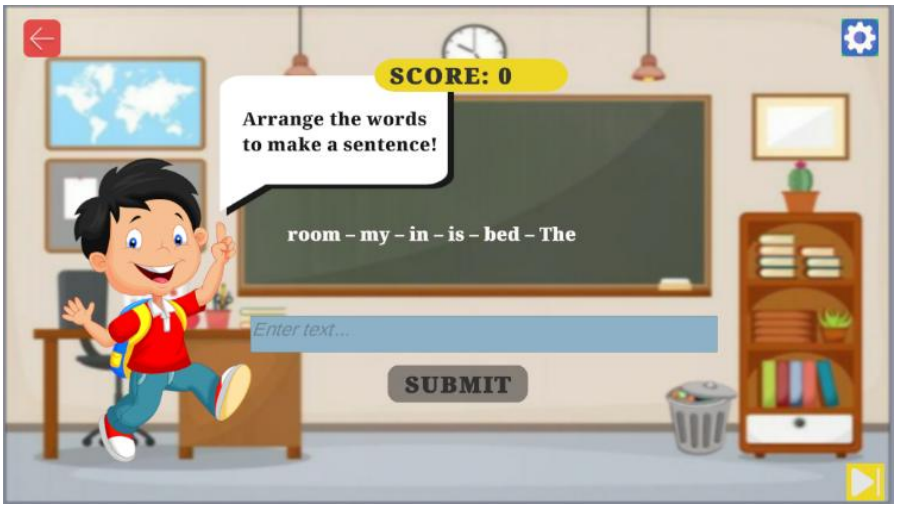

Figure 6. Arrange the Sentence Question

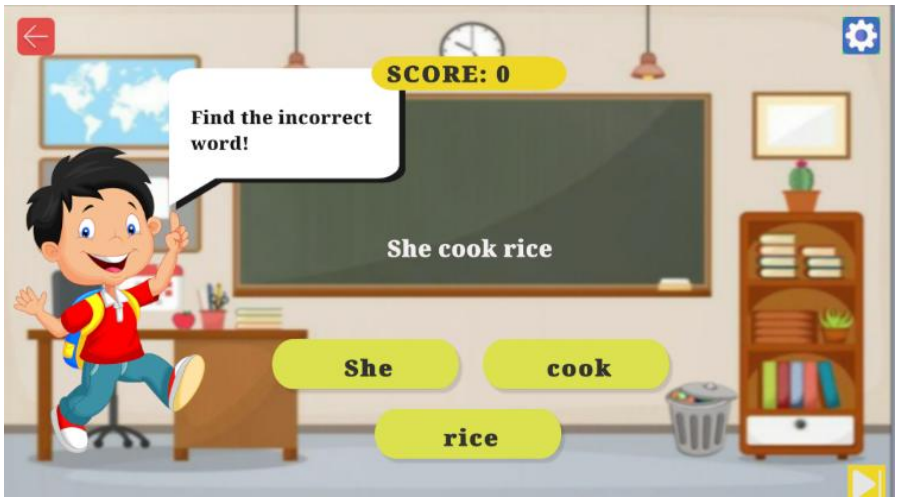

Figure 7. Find Incorrect Word Question

3.2 Implementation of Material and Questions

The questions in the game are structured based on the material mapping in the English teaching module for grade 4 of SD N 2 Ngemplak, Sleman, Yogyakarta. This mapping was conducted to ensure that the questions used are related to the learning objectives in each chapter. A summary of the material and level mapping is presented in Table 2.

Table 2. Game Level Mapping with Teaching Modules

Level	**Teaching Module Reference**	**Main Material**	**Number of Questions**
1	Chapter 1: What Are You Doing?	Activities using verb-ing	10
2	Chapter 2: There Are 67 English Books	Numbers 50-100	10
3	Chapter 3: My Licing Room is Beside Kitchen	Rooms and prepositions	10
4	Chapter 4: Cici Cooks in The Kitchen	Activities at home	10
5	Chapter 5: Where is My Pencil?	Objects in the room	10
6	Chapter 6: The Stove is in The Kitchen	Items in the kitchen and bathroom	10
7	Chapter 7: I can Make Fried Egg in The Kitchen	Activities with ‘can’ word	10
8	Chapter 8: Be on Time!	Time and hours	10
9	Chapter 9: I Go to School after Having Breakfast	Daily activities and time	10
10	Chapter 10: He Always Gets Up at 5 O’clock	Adverb of frequency	10
11	Chapter 11: How Do You Go To School?	Transportation	10
12	Chapter 12: He Goes to School by Bike	Transportation and daily activities	10

Question mapping was also used as a basis for validation by the fourth-grade homeroom teacher at SD N 2 Ngemplak, Sleman, Yogyakarta. The teacher assessed whether the developed questions were aligned with the module chapter, learning objectives, student ability levels, answer keys, and clarity of the question language. This validation process was necessary to ensure that the questions in the game were not only technically appropriate but also pedagogically sound.

3.3 Audio Implementation

English educational games are equipped with three types of audio: BGM, SFX, and pronunciation audio. BGM is used as background music during gameplay. SFX is used as sound effects when students answer correctly or incorrectly. Pronunciation audio is used to read questions and correct answers after students answer.

In Unity, audio is managed using the Audio Source component. This component is used to store audio files, adjust volume, and play in-game sounds. The Play On Awake feature allows audio to play automatically when an object is active, while the Loop feature allows background music to repeat throughout the game. With pronunciation audio, students receive information not only through text and images but also through sound. This helps them hear correct English pronunciation during gameplay.

3.4 Black Box Test Results

Black Box testing was conducted to ensure that every function in the game runs according to design. Testing was conducted on the Main Menu, About, Settings, Exit, Level Menu, question pages, scoring system, audio, and results pages. Testing was conducted by examining the page, input, process, output, and validity. The results of the Black Box Testing are shown in Table 3.

Table 3. Black Box Test Results

No	Interface	Input	Process	Output	Validitas
1	Main Menu	The user presses the Play button	The system processes command to open the game menu	English Play/Menu page is displayed	Valid
		The user presses the About button	The system processes the command to open game information.	The About page is displayed.	Valid
		The user presses the Exit button	The system processes the exit command from the game.	The logout confirmation page is displayed.	Valid
		The user presses the Settings button	The system processes the command to open the sound settings.	The Settings page is displayed.	Valid
2	Page of About	User presses the Back button	The system processes the command back to the previous page.	The system returns to the Main Menu	Valid
3	Page of Setting	User presses the Mute button	The system disables BGM and SFX	Game sound/music is not audible	Valid
		User presses unmute button	The system reactivates BGM and SFX	Game sounds/music are back	Valid
		User presses the Back button	The system processes the command to return to the previous page.	The system returns to the Main Menu page	Valid
4	Page of Exit	The user presses the Yes button	The system processes out	Closed game	Valid

		The user presses the No button	The system canceled the exit command.	The system returns to the Main Menu	Valid
5	Level Menu	The user selects a level that is already open.	The system saves the selected level via GameData	The system moves to the question page according to the level	Valid
		User selects a level that is still locked	The system checks the level status via PlayerPrefs	Level cannot be unlocked	Valid
6	Page of Multiple-Choice Questions	User selects the correct answer	The system checks the answers and adds scores.	The button turns green and the score increases.	Valid
		User selected wrong answer	The system checks the answers	The button turns red and the score does not increase.	Valid
7	Page of True/False Questions	User selects the correct answer	The system checks the True/False option	The button turns green and the score increases.	Valid
		User selected wrong answer	The system checks the True/False option	The button turns red and the score does not increase.	Valid
8	Page of Arrange the Sentence Question	The user types the correct sentence structure and then presses Submit.	The system compares the user's answer with the answer key.	The text Correct! and the score increases	Valid
		The user types the wrong sentence structure and then presses Submit.	The system compares the user's answer with the answer key.	Incorrect text appears! and the score does not increase	Valid
9	Page of Incorrect Word Question	User chooses wrong word with correct answer	The system compares the selected button with the answer key.	Tombol berubah hijau, koreksi muncul, dan skor bertambah	Valid
		User selects a word that is not the answer	The system compares the selected button with the answer key.	Tombol pilihan berubah merah, jawaban benar berubah hijau, dan koreksi ditampilkan	Valid
10	Page of Questions	Users try to answer questions that have already been answered	The system checks the question status through the answered variable.	The answer cannot be reprocessed.	Valid
		Users complete all questions in one level	Sistem menghitung skor akhir	The game results page is displayed.	Valid
11	Page of Results	The system displays the final score	The system takes the score obtained by the player	The final score is displayed on the results page.	Valid

		The system displays Stars based on the score	The system processes the player's score values.	Stars are displayed according to the score achieved.	Valid
		The user presses the continue button	The system processes the command back to the menu level.	The Level Menu page is displayed.	Valid
		Player completes level	The system saves the progress of the next level using PlayerPrefs.	Next level is open	Valid

Based on Table 3, all the main functions in the game performed as expected. Every user input was processed by the system and produced the appropriate output. Thus, the game was declared functionally valid.

3.5 User Acceptance Test Results

A User Acceptance Test was conducted to determine students' level of acceptance of an English language educational game. This test is suitable for use in educational game products because it can reflect user responses to the developed media [12]. The test was conducted after students tried the game in the school computer lab. Aspects assessed included ease of use, display, audio, question clarity, and the game's usefulness as a learning aid.

The UAT results obtained a total score of 1,175 out of a maximum score of 1,400. The UAT percentage calculation is as follows:

$$Percentage = \frac{1175}{1400} \times 100\% = 83{,}93\% \quad (2)$$

These results are included in the very good category, the recapitulation of UAT results is presented in table 4.

Table 4. User Acceptance Test Results

Assessment Aspects	**Total Score**	**Maximum Score**	**Percentage**	**Category**
User acceptance of the game	1.175	1.400	83,93%	Excellent

The UAT results showed that students responded positively to the English language educational game. The game was deemed easy to use, engaging, and helpful in learning English vocabulary. These results indicate that the game is acceptable as a learning aid.

3.6 Discussion

The development results indicate that a desktop-based English educational game can be used as a learning aid appropriate to school conditions. The choice of an offline desktop platform was based on the availability of computer laboratories and the need for learning media that does not rely on an internet connection. This differentiates it from previous studies that primarily developed Android-based English educational games [3], [7].

In terms of content, the game's questions are structured based on the 4th-grade English language learning module of the Independent Curriculum at SD N 2 Ngemplak, Sleman, Yogyakarta. Mapping the material into 12 levels creates learning objectives for students. Thus,

the game is not only developed as a visually appealing digital product but also has a learning foundation tailored to students' needs.

The variety of question models in the game supports vocabulary and simple sentence learning. Multiple-choice and true/false questions help students recognize vocabulary and understand simple statements. Arrange the sentence questions help students understand word order in English. Find the incorrect word questions help students identify word usage errors in simple sentences. The variety of questions is in line with the needs of Phase B English learning which emphasizes understanding simple vocabulary, patterned sentences, and visual aids [1].

Audio features are one of the supporting elements in the game. BGM is used to create a game atmosphere, SFX is used as feedback when students answer correctly or incorrectly, while pronunciation audio provides students with feedback not only visually but also audibly. This can help students hear correct English pronunciation while playing the game.

Black Box Testing results indicate that the game's main features operate validly. This indicates that menu navigation, level selection, audio settings for answering questions, feedback, the scoring system, and the results page are all in accordance with the design. The UAT result of 83.93% indicates that the game received very good acceptance from students. This finding aligns with previous research showing that educational games can be an engaging learning medium and support English learning in students [2], [3]. Furthermore, this research finding is also supported by research by Dwiyanto and Irianto [4], Sasongko et al. [5], and Wibowo and Irianto [6], all of which demonstrate that games can be developed as supporting media and evaluated through functional testing and user acceptance.

4. CONCLUSION

Based on the research results, it can be concluded that a desktop-based English educational game was successfully developed as a learning aid for fourth-grade students at SD N 2 Ngemplak, Sleman, Yogyakarta. The game can be run offline via the school's computer laboratory, thus adapting to the school's facilities and learning needs. Furthermore, the game includes fourth-grade English material based on the Independent Curriculum teaching module, ensuring that the game's content aligns with students' learning objectives.

The game consists of 12 levels with a total of 120 questions. The questions are based on the fourth-grade English teaching module of the Independent Curriculum and are supported by the My Next Words Grade 4 textbook. The question formats used include multiple-choice, true/false, arrange the sentence, and find incorrect words. The game also features background music (BGM), sound effects (SFX), pronunciation audio, a scoring system, and answer feedback to help students understand the material more interactively.

Black Box Testing results indicate that all of the game's main features functioned validly. User acceptance testing was conducted using a User Acceptance Test (UAT) involving 28 fourth-grade students from SD N 2 Ngemplak, Sleman, Yogyakarta. The UAT results achieved a score of 83.93%, categorized as excellent. Therefore, the English educational game can be used as a learning aid to help students learn vocabulary and simple sentences before or during teacher explanations.

5. FUTURE DIRECTION

This English educational game will be further developed in future research. The game could be enhanced with a feature for storing student learning outcomes so teachers can view their scores and achievements at each level. This feature could assist teachers in monitoring student learning outcomes after using the game as a learning aid.

User tracking features could also be added so each student has their own gameplay data. This data could include gameplay history, highest scores, and level progress. Furthermore, the material and questions could be expanded to other grade levels so that the game's use isn't limited to 4th grade.

The pronunciation audio feature could be further developed by adding options for voice repetition, word-by-word pronunciation, or voice variations. This development is expected to help students imitate English pronunciation more easily. Further testing in future research could involve more students and different schools to ensure a more representative user acceptance evaluation.

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