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Design and Build an English Furniture Vocabulary Learning Application Based on Augmented Reality

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ABSTRACT
The research aims to design and build an English furniture vocabulary learning application. This research is Research and Development (R&D). The method that used in this research was Four D by Thiagarajan which consists of four stages: 1) define, 2) design, 3) develop, and 4) disseminate. Software testing uses ISO 9126, which focuses on the characteristics of functionality, maintainability, portability, and usability. The results of testing the functionality aspect by expert validation show that the application is feasible to use. Testing of maintainability characteristics was carried out by software testing on the sub-characteristics of analyzeability, changeability, and stability, and the results of the tests carried out indicated that, in terms of maintainability, the application was good. Testing the portability aspect is carried out by running the application on several mobile devices with different Android operating systems, showing that the quality of the software in terms of portability has a very good scale. Usability testing research subjects were 32 respondents from students at MAN 1 Makassar, based on the test conducted the research subjects showed very good responds to the application. Based on the proposed characteristics of ISO 9126, the application is very feasible to use in actual situations and conditions.

Keywords: *Learning, English Vocabulary, Augmented Reality, ISO 9126.*

1. INTRODUCTION

Language is a very important element in our lives because language is a tool for human interaction to convey messages or ideas that are in their minds. Therefore, the presence of language as a communication tool to convey messages or ideas provides benefits in social life.

English is a language that originated in England. English is the main language in the United Kingdom (including England) and the United States. English is used officially by 61 countries on six continents, thus making English a language that can connect one country to another despite national language differences.

As a language that is widely used, making this language have a strong influence on other countries, including Indonesia. The said influence can be seen in the globalization era. It is undeniable that globally, various world informations are contained in English, so in order to access it, people must have their own mastery of that language.

Unfortunately, the problem is that our foreign language proficiency, especially English, are still low. The world educational institution EF (English First) has announced the third edition of its comprehensive report on its English proficiency index, or EF English Proficiency Index (EF EPI), in 60 countries. English proficiency in Indonesia is very low at 25th, while Malaysia is at 11th. Seeing this fact, we really hope that English can get better in the future because, inevitably, low English proficiency cannot be separated from the less optimal role of schools in teaching English.

One of the obstacles in the process of learning English is the lack of adequate learning facilities [1]. This was illustrated when the researcher conducted interviews at the MAN 1 Makassar school. The writer found that many students, especially in class XII, had difficulties memorizing vocabulary. The writer then also found that the media used by the teacher to teach were whiteboards and power points.

The researcher is interested in developing a concept that can become a medium for students in Indonesia to

improve the quality of the learning process and their ability to speak English, especially in vocabulary mastery, which is crucial in learning English. The researcher then concludes that utilization of technology is the answer.

The influence of audio-visuals in learning has been put forward by Edgar Dale (in Wagner, 1970) in the "Cone of Experience" which states that audio-visuals can concretize abstract things in learning [2]. Then, according to Toheri, the magnitude of the learning outcomes of 10th grade students in learning using audio-visual learning media was 72.25%, while the remaining 27.75% was caused by other factors [3].

Augmented Reality aims to develop technology that allows for the real-time merging of digital content created by computers with the real world [4]. Augmented Reality allows users to see two-dimensional or three-dimensional virtual objects projected onto the real world.

Therefore, the researcher tries to produce an application product that can provide a visual effect on learning English using Augmented Reality technology and also provides audio related to learning, which is expected to be more contextual in learning.

2. METHOD

Research design that was conducted is Research and Development (R&D) that developing English Furniture Vocabulary Learning Application Based on Augmented Reality. This product was built using a software development model approach, namely the 4D by Thiagarajan.

The Four-D (4-D) Model was developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel which consists of four stages. This method and model were chosen because the implementation stages are divided systematically.

A requirements analysis (define) is carried out in order to collect the data needed for developing software that is tailored to user needs. The developer must understand the required information, behavior, performance, and appearance. Software requirement specifications need to be documented.

The design stage is an overview of the process that can be carried out by the software, which is developed with an eye toward appearance and planned according to the requirements analysis. The design stage translates the software requirements from the requirements analysis stage into a program at the coding stage.

The development stage is divided into two activities, namely, expert appraisal and developmental testing. Expert appraisal is a technique to validate or assess the feasibility of a product design. In this activity, an evaluation is carried out by experts in their fields. In this study, it will be validated by two media experts, two material experts, and two instrument experts.

The suggestions given are used to improve the materials and designs that have been prepared. Developmental testing is a product design trial activity on the actual target subject, which in this case are students from the 11th grade from MAN 1 Makassar: 3 students in the one-to-one trial stage, 9 students in the small group trial stage, and 30 students in the expanded/field trials. Data Collection Methods used to obtain the data needed in this study, namely: interviews, questionnaires, and documentation.

The dissemination process is the final stage of development so that it can be accepted by users, either individuals, groups, or systems. In this application, the dissemination or deployment process will be carried out by uploading the application's Apk. file to the Play Store so that users can download it.

2.1. Data Analysis Technique

2.1.1. Functionality Analysis

2.1.1.1. Media Experts' Appraisal

Functionality testing by media experts is determined by the results of calculating the percentage score for each instrument. On the answer sheet, rate each question item using the Guttman scale. According to Sugiono (2019), a measurement scale of this type will get a firm answer, such as yes or no, right or wrong, ever or never, positive or negative. Answers can be made in the form of a checklist with a high score of 1 and a low score of 0. The Table 1 is a score conversion from the Guttman scale.

Table 1. The Category of Media Experts' Appraisal

Jawaban	Skor Jawaban Instrumen	Hasil
Ya	1	∑Ya
Tidak	0	∑Tidak
Skor Maks		∑Ya+∑Tidak

The percentage for each assessment is:

Ya = (∑ Ya/Skor Maks) x 100%

Tidak = (∑ Tidak/Skor Maks) x 100%

The collected data were analyzed using qualitative descriptive analysis techniques, which were expressed in the frequency distribution and percentage of the rating scale category that had been determined from its percentage form. Furthermore, if the feasibility percentage has been obtained, conclusions can be drawn to produce qualitative data using the conversion table as shown in Table 1.

Table 2. Qualitative Conversion of the Percentage of Eligible Media Experts

Presentation of Eligibility	Criteria
≥ 50%	Feasible
< 50%	Not Feasible

2.1.1.2. Program Experts' Appraisal

Functionality testing by program experts is determined based on program quality categorization criteria adapted from the categorization according to Saifuddin Azwar [5], as follows:

Table 3. Alternative Scoring Categories of Program Expert Answers

4,2 ≤*M* ≤ 5,0	category	Very Feasible
3,4 ≤*M* <4,2	category	Feasible
2,6 ≤*M* <3,4	category	Feasible Enough
1,8 ≤*M* <2,6	category	Barely feasible
1,0 ≤*M* <1,8	category	Not Feasible

M= Mean

2.1.1.3. Material Experts' Appraisal

Functionality testing by program experts is determined based on program quality categorization criteria as follows:

Table 4. Alternative Scoring Categories of Material Expert Answers

4,2 ≤*M* ≤ 5,0	category	Very Feasible
3,4 ≤*M* <4,2	category	Feasible
2,6 ≤*M* <3,4	category	Feasible Enough
1,8 ≤*M* <2,6	category	Barely feasible
1,0 ≤*M* <1,8	category	Not Feasible

M= Mean

2.1.2. Maintainability Analysis

Analysis of maintainability characteristics is carried out using measurements (metrics), which are then tested operationally. These metrics consist of analyze ability, changeability, and stability.

2.1.3. Portability Analysis

In order to determine whether or not this application can run on Android smartphones with varied specifications and Android OS versions, analysis for the features of portability testing employs a web testing tool, namely Test Fairy. Furthermore, the percentage score of the test results is calculated, and when the calculation results are then compared with the product conformity rating scale, which has attained a very excellent scale, it can be said that the generated application has satisfied the portability feature.

2.1.4. Usability Analysis

Implementing descriptive statistical analysis to test usability characteristics. Quality analysis for usability characteristics is carried out using a questionnaire instrument. Questionnaires were distributed to eleventh grade students at MAN 1 Makassar, including 3 students at the one-to-one trial stage, 9 students at the small group trial stage, and 30 students for expanded or field trials. Each question item's responses on the usability questionnaire are graded on a Likert scale. Scores from the questionnaire's Likert scale are converted in Table 4.

Table 5. Likert Scale Conversion Table

Answer	Score
Strongly Disagree	1
Disagree	2
Indecisive	3
Agree	4
Strongly Agree	5

Additionally, the scores in Table 4 are divided into the following categories:

Table 6. Categorization Criteria

4,2 ≤*M* ≤ 5,0	category	Very Good
3,4 ≤*M* <4,2	category	Good
2,6 ≤*M* <3,4	category	Good Enough
1,8 ≤*M* <2,6	category	Not Good Enough
1,0 ≤*M* <1,8	category	Not Good

M= Mean

3. FINDINGS AND DISCUSSION

3.1. Analysis of Data/ Material Needs

In analyzing this data and material, the author made direct observations at several senior high schools and conducted searches on several websites that discussed vocabulary learning. This is necessary to know the book or vocabulary material that is usually taught. So that the material content and features contained in the following application are in accordance with the learning conditions for children and school students.

3.2. Application Interface

Based on the research, an augmented reality application for Android mobile devices that visualizes furniture objects has been developed. This application is named EnglishAR (English Augmented Reality). This application was built using Unity3D software as the main engine. And using additional software such as the Vuforia SDK and Android SDK to build the virtual-augmented reality features of this application.

Figure 1. Main Menu Splash Screen Interface

Figure 2. The Interface of Bed in AR

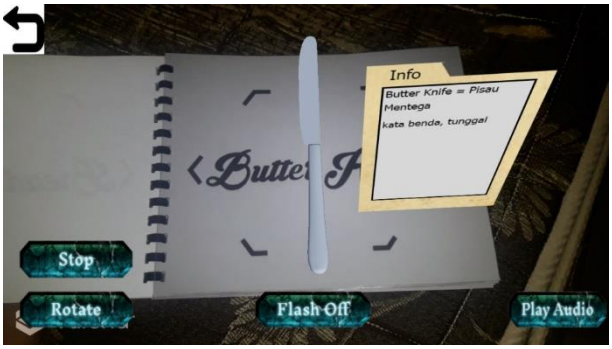

Figure 3. The Interface of Butter Knife in AR

Figure 4. The Interface of Couch in AR

Figure 5. The Interface of Fridge in AR

Figure 6. The Interface of Iron in AR

3.1. Functionality Testing

This application is given a series of software quality standard tests, namely ISO 9126, which focus on four characteristics: functionality, portability, and maintainability. Each characteristic will be tested with a separate instrument.

Functionality quality testing and assessment are carried out by two expert validators for each test on aspects of media, programs, and materials.

3.1.1. Media Expert Assessment

Table 6 displays a summary of the results from media experts' testing and evaluation of the functionality quality of the products during development.

Table 6. Summary of The Results from Media Experts' Assessment

No.	Assessor	Total Score	Max. Score	Percentage (%)	Category
1	Validator 1	17	17	100	Feasible
2	Validator 2	17	17	100	Feasible
Average		**17**	**17**	**100**	
Result		**Feasible**			

Table 6 above shows that the total score of the two validators is 17 each with a percentage of 100%, so it can be concluded that the developed media is feasible to use at the trial stage.

3.1.2. Program Expert Assessment

Table 7 displays a summary of the results from program experts' testing and evaluation of the functionality quality of the products during development.

Table 7. Summary of The Results from Program Experts' Assessment

No.	Assessor	Score	Category
1	Validator 1	4.39	Very Feasible
2	Validator 2	4.28	Very Feasible
Average Score		**4.33**	**Very Feasible**

Table 7 above shows that Validator 1's score was 4.39 in the "Very Feasible" category, and Validator 2's score was 4.28 in the "Very Feasible" category. The Average score of the two validators is 4.33. Based on the average score, it can be concluded that the developed media is very feasible for use at the trial stage.

3.1.3. Material Expert Assessment

Table 8 displays a summary of the results from program experts' testing and evaluation of the functionality quality of the products during development.

No.	Assessor	Score	Category
1	Validator 1	4.82	**Very Feasible**
2	Validator 2	4.86	**Very Feasible**
Average Score		**4.84**	**Very Feasible**

Table 8 above shows that Validator 1's score was 4,82 in the "Very Feasible" category, and Validator 2's score was 4,86 in the "Very Feasible" category. The Average score of the two validators is 4,84. Based on the average score, it can be concluded that the developed material is very feasible for use at the trial stage.

3.2. Maintainability Testing

Table 8. Maintainability Test Results

No.	Statement	Sub-characteristics	Test result
1	There is a warning in the application to identify errors.	*Analyzability*	The results of the tests conducted indicate that when an error happens, the application will send out an error warning message to let users know there is a problem, such as when a programming error occurs. This makes it very simple throughout the application repair process because the presence of a notification message on the console also clarifies the location of the mistake.
2	Application development, maintenance, and repair flexibility.	*Changeability*	The results obtained from the test show that the application is easy to repair and develop because it uses the easy-to-use Unity3D software. When there is a malfunction of a component or code, it can be traced directly to that part. For example, if there is an error in the program code, the developer only needs to look for what errors are found in the console and then fix the wrong part of the program code.
3	The ability of an application to minimize the unanticipated effects of modifications	*Stability*	The test's findings demonstrate that the application can continue to function normally and that there are no crashes as a result of the modifications.

3.3. Portability Testing

Table 8. Portability Test Results

No	Type of Device	OS Version	Installation Process	Application Running Process
1	Xiomi Redmi 4	6.0.1 (Marshmallow)	Success	Runs without any issues or error messages
2	Xiomi Redmi 3	5.1.1 (Lolipop)	Success	Runs without any issues or error messages
3	Xiomi Redmi 3 Note	6.0.1 (Marshmallow)	Success	Runs without any issues or error messages
4	Samsung J7 Prime(SM-G610F)	6.0.1 (Marshmallow)	Success	Runs without any issues or error messages
5	Samsung S5 Prime(SM-G900F)	6.0.1 (Marshmallow)	Success	Runs without any issues or

				error messages
6	ZUKZ2131	7.0 (Nougat)	Success	Runs without any issues or error messages
7	OPPO F1f	5.1.1 (Lolipop)	Success	Runs without any issues or error messages
8	OPPO A6103	5.1.1 (Lolipop)	Success	Runs without any issues or error messages
9	OPPO A33W	5.1.1 (Lolipop)	Success	Runs without any issues or error messages

The results of testing the application from the portability aspect are carried out by calculating the percentage. The percentage calculation in the portability test is as shown in Table 9.

Table 9. Portability Calculation Percentage

No	Test	Score	Success	Fail
1	Installing applications on smartphones	9	9	0
2	Run the application on the smartphone	9	9	0
Total		**18**	**18**	**0**

Thus, the percentage of assessment is:

$$\text{Percentage} = \frac{Result\ Score}{Total\ Score} \text{ x } 100\%$$

$$\text{Percentage} = \frac{18}{18} \text{ x } 100\% = 100\%$$

Based on the calculation above, a percentage of 100% is obtained from the portability test. Based on the application product rating scale from the percentage score obtained, the quality of the application in terms of portability has a "Very Good" scale and meets the characteristics of portability.

3.4. Usability Testing

3.4.1. One-to-one Test

Table 10. One-to-one Test Result

No.	Users	*Number of Items*	Total Score	Average/Mean	Category
1	NN 1	19	86	4,5	Very Good
2	NN 2	19	83	4,4	Very Good
3	NN 3	19	81	4,3	Very Good
Average Score				4,4	Very Good

3.4.2. Small Group Test

Table 11. Small Group Test Result

No.	Users	*Number of Items*	Total Score	Average/ Mean	Category
1	NN 1	19	88	4,6	Very Good
2	NN 2	19	74	3,9	Good
3	NN 3	19	95	5,0	Very Good
4	NN 4	19	94	4,9	Very Good
5	NN 5	19	79	4,2	Very Good
6	NN 6	19	82	4,3	Very Good
7	NN 7	19	93	4,9	Very Good
8	NN 8	19	92	4,8	Very Good
9	NN 9	19	96	4,5	Very Good
Average Score				4,6	Very Good

3.4.3. Field/expanded Test

Table 12. Expanded Test Result

No.	Users	*Number of Items*	Total Score	Average/Mean	Category
1	NN 1	19	86	4,5	Very Good
2	NN 2	19	81	4,3	Very Good
3	NN 3	19	95	5,0	Very Good
4	NN 4	19	94	4,9	Very Good
5	NN 5	19	74	3,9	Good
6	NN 6	19	82	4,3	Very Good
7	NN 7	19	92	4,8	Very Good
8	NN 8	19	90	4,7	Very Good
9	NN 9	19	85	4,5	Very Good
10	NN 10	19	85	4,5	Very Good
11	NN 11	19	89	4,7	Very Good
12	NN 12	19	90	4,7	Very Good
13	NN 13	19	86	4,5	Very Good
14	NN 14	19	89	4,7	Very Good
15	NN 15	19	95	5,0	Very Good
16	NN 16	19	89	4,7	Very Good
17	NN 17	19	90	4,7	Very Good
18	NN 18	19	87	4,6	Very Good
19	NN 19	19	86	4,5	Very Good
20	NN 20	19	90	4,7	Very Good
21	NN 21	19	84	4,4	Good
22	NN 22	19	89	4,7	Very Good
23	NN 23	19	88	4,6	Very Good
24	NN 24	19	86	4,5	Very Good

25	NN 25	19	85	4,5	Very Good
26	NN 26	19	86	4,5	Very Good
27	NN 27	19	88	4,6	Very Good
28	NN 28	19	87	4,6	Very Good
29	NN 29	19	95	5,0	Very Good
30	NN 30	19	91	4,8	Very Good
31	NN 31	19	89	4,7	Very Good
32	NN 32	19	90	4,7	Very Good
Average Score				4,6	Very Good

4. CONCLUSION

Based on the results of the research that has been done, it can be concluded that: (1) functionality: based on the results of the media expert's assessment that the developed media is feasible for use at the trial stage, the results of the program expert's assessment that the media developed are very feasible for use at the trial stage, and the results of the material expert's assessment that the developed media is very feasible for use at the trial stage; (2) Maintainability is done by software testing on the sub-characteristics of analyzeability, changeability, and stability. shows the three sub-characteristics assessed on the application from a very good maintainability perspective: (3) portability by running applications on several mobile devices with different Android operating systems. The results obtained are based on the application product rating scale; from the percentage score obtained, the quality of the software in terms of portability has a very good scale and has fulfilled the portability aspect. (4) An augmented reality-based furniture English learning vocabulary application was produced. This application runs on an Android smartphone device and is combined with a vocabulary book.

Based on the results of user responses to the augmented reality-based furniture English learning vocabulary application, it can be concluded that: (1) based on one-to-one trials, it can be concluded that the application is stated to be very good; (2) based on small group trials, it can be concluded that the application is declared very good; (3) based on the expanded trial, it can be concluded that in the expanded trial the application was stated to be very good;

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