The Evaluation of Augmented Reality Dictionary to Improve English Vocabulary

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ARTICLE INFO	ABSTRACT
	English is an important subject for scoring in primary and secondary school exams in Malaysia. However, students are exposed to countless grammatical errors and are affected by the dialect they use in daily communication, especially for students who live in Kelantan. They are used to the use of dialect words in daily conversation. Therefore, they faced difficulties in understanding and translating the words from Bahasa Melayu to English. Furthermore, there is a lack of mobile application dictionaries to help primary school students to translate Kelantan's dialect into English. The objectives of this research are (i) to analyse the needs and requirements to develop an AR mobile application to translate Kelantan's dialect into English, (ii) to develop an AR mobile application that can look up the meaning of Kelantan's dialect in English accurately, (iii) to evaluate the usability of the mobile application in terms of compatibility, consistency, flexibility, and learnability, and (iv) to evaluate the effectiveness of the mobile application to improve the vocabulary of the users. ADDIE model has been chosen in this research which consists of five phases involved in completing this research which is: (i) analysis phase, (ii) design phase, (iii) development phase, (iv) implementation phase, and (v) evaluation phase. The main contribution of this research is an AR mobile application Kelantan Dictionary called MyBrainy Kelate for primary school to improve English vocabulary. MyBrainy Kelate will help primary school students who have difficulties translating Kelantan's dialect words into English words. The usability testing proved that MyBrainy Kelate has met the requirements of usability elements. Meanwhile, the effectiveness testing proves that the application is an effective tool for the user to improve their knowledge of English vocabulary. For future works, the research can be improvised by taking into consideration the game-based learning in the mobile application. The playability test can be conducted to test the playability of the game.

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1. Introduction

Primary school is part of the Malaysian education system. The Ministry of Education provides primary schools to enable children aged six (6) to twelve (12) years old to enter school, especially children from low-income groups. The Government Transformation Programme (GTP) focuses on six National Key Result Areas (NKRA) including expanding access to quality and affordable education [1]. Education is one of the NKRA priorities by the Government as surveys and surveys conducted by various private parties and the government found that education is a matter that is very close to the hearts of many. Aspirations Education NKRA is focused on increasing student achievement across the board, including intellectual, emotional, spiritual, and physical boost the image of the country's education system.

Increasing student achievement at all levels is important in developing the talent to produce skilled manpower so that the desire to develop countries by 2020 is achieved. Inspirations NKRA also ensures quality and affordable education enjoyed by all parties to improve the standard of living overall. Education NKRA has set two main focuses basis for the transformation of ensuring that all children receive quality basic education and developing a culture of achievement to drive the transformation of the education system. Accordingly, preschool education, literacy, and numeracy skills at standard one can promote excellence based on performance-based assessment used as a sub-field given NKRA's main focus.

In a way to help the government achieve the objective of NKRA, this research provides a platform for primary school students to master basic language using the advantages of technology especially Augmented Reality and mobile devices. The idea of mobile learning should be used to improve pedagogical activities in course delivery at any time [2]. Although still in its infancy, mobile learning has been included in Malaysia's educational system. Previous studies that have been carried out in numerous kindergartens and primary schools in Malaysia have demonstrated that students who use mobile devices for learning do so with acceptability and a high inclination [3-6]. Previous studies also proved that there is an increment in knowledge after using technology-based learning [7-9]. Thus, mobile learning combined with augmented reality (AR) can heighten student interest while also enhancing their concentration and performance.

This opportunity can help Kelantan's primary school students aged between 7 and 9 years old improve their English vocabulary. Some school children in Kelantan are being taught to pronounce the word 'cucumber' as "*Chu Chum Ber*". They are also being told by their teachers that hibiscus should be pronounced: "*Hee Bis Coose*". This shocking assertion concerning the purportedly subpar quality of English teachers in Kelantan schools was made by a Dewan Negara senator. Students are exposed to many grammatical errors and are impacted by the dialect they use in everyday interactions, so this is just the tip of the iceberg in terms of the issue [10].

Moreover, a report published by JPN Kelantan shows that the percentage of English in UPSR results for the national school, overall performance dropped by 0.12 GPMP points compared to 2014 [11]. The percentage of candidates getting Grade A decreased by 4.66% and Grade ABC also decreased by 1.15% compared to 2013. The percentage of candidates who did not reach the minimum level of Grade D and Grade E increased by 0.78% and 0.35% respectively [11].

There is also a lack of AR mobile applications to help primary school students translate Kelantan dialect words into English words. Therefore, this research is important to study the usability guidelines and best practices in designing mobile applications so that one service application can be developed. This is because of the lack of AR mobile applications that can be used to help the children in Kelantan to effectively master English vocabulary.

The Government hopes to see the Education NKRA will be able to produce excellent human capital for the development of manpower to drive the national economy to reach the New Economic Model, thus achieving Vision 2020 as envisaged. Thus, this study will achieve the government's hope with the advantages of mobile technology implemented in the learning process for primary school students in Malaysia. Four (4) research objectives outlined for this research are as follows:

i. To analyse the needs and requirements to develop an AR mobile application to translate Kelantan's dialect into English.
ii. To develop an AR mobile application that can look up the meaning of Kelantan's dialect in English accurately.
iii. To evaluate the usability of the mobile application in terms of compatibility, consistency, flexibility, and learnability.
iv. To evaluate the effectiveness of the mobile application to improve the vocabulary of the users.

2. Literature Review
2.1 Kelantan Dialect

A preliminary study of *Orghe Kelate* had been conducted by Pawanteh [12] and it shows that when the people of Kelantan call themselves *Orghe Kelate*, what they have in mind is an exclusive, almost tribal in nature, socio-geographic group. Members of this group would stand out from those originating from other Malaysian states and regions, by differences in usage of a unique Kelantanese dialect (a hybrid of the Malay language), hence taking a name popularly known as *Loghat Kelate*. Influence of Thai (due to the geopolitical proximity of the state of Kelantan with the south of Thailand), Arabic, and Chinese (due to the historical presence and influence of traders from the latter two cultures) is present not only in the *Loghat Kelate* but also in the mannerism or (courtesy code) of the *Orghe Kelate*.

In the Kelantan dialect, every word ending with the letter 'n', 'm', and 'ng', will be replaced with the letter 'è'. For example, *orang*, which means people in Malay, will be said to *ore* in the Kelantan dialect. However, this rule can only be applied when there is a vowel 'a' before the letter 'n', 'm', or 'ng'. There are many variations of the Kelantan dialect, such as, how to pronounce the word depending on the words itself.

The dialect did not have much difference between the administrative jurisdictions in Kelantan. However, there is a certain district in Kelantan such as Rantau Panjang that has a difference in the dialect. It is because Rantau Panjang is a border of Malaysia-Thailand, thus affecting the speech in them. The majority of Kelantanese in Golok, Rantau Panjang use the Malay-Pattani dialect rather than the Thailand dialect [13]. This dialect occurred because of the social, language, and culture in the Thailand border. There are two patterns of language use among the younger generation on the border of Thailand. Malay-Patani dialect is dominantly used at home, while Thai is the main language outside the home, which is when chatting with friends.

In conclusion, because of the characteristics that highlight Kelantan's distinctiveness from other states in Malaysia, it stands out as an intercultural communication entity. The Kelantan people have been able to develop a distinct and exclusive identity that can ultimately be conceived as a Kelantan State Identity because of their exceptional intercultural communication skills. Furthermore, many factors produce the differences in Kelantan's dialect, such as social, language, and culture in the area.

2.2 The Advantages of Using Mobile AR Application Dictionary in Education

An electronic dictionary is a portable electronic device that stores data in the digital form of any dictionary. An electronic dictionary is available in several forms, including hand-held devices, and mobile phones. A mobile application dictionary is a dictionary whose function was built into the mobile phone. The dictionary can be installed by the users themselves. There are many advantages to using this mobile application dictionary.

An experiment of the Oxford Placement Test (OPT) had been conducted by Murnani *et al.,* [14]. Two groups of learners, which are a group of the control group, and the experimental group were given 64 new collocations. The control group recognized the collocation by prior knowledge, whereas the experimental group employed an electronic collocation dictionary to determine what the collocation meant. The outcomes demonstrated that the experimental group did noticeably better than the control group. It supported the claim that teaching collocations with an electronic dictionary can speed up the learning process. Mobile application dictionary is an evolution of the electronic dictionary, which has been added with additional features.

The most visible advantage of the mobile application dictionary is its convenience to use. Students do not have to waste time by seeking new words on pages as the mobile application dictionary has a fast query to ease users in finding the words. Students need to carry a big dictionary while using printed dictionaries since smaller, more portable dictionary books do not have enough entries to be useful. However, the student can put an end to it by having a mobile application dictionary that has bigger word storage. Traditional printed dictionaries eventually become obsolete since they are cumbersome to carry around and difficult to search.

Furthermore, mobile-application dictionary nowadays is being advanced by making specific features for certain target users. A dictionary for the visually disabled will have huge buttons and a screen, with customizable font sizes as well as pronunciation while a dictionary that was designed for children will have an entertaining user interface. As an example, Panchal *et al.,* [15] stated that to help visually impaired students overcome the challenges they encounter during their educational instruction, they are introducing interactive audio dictionary learning tools. It is an audio dictionary that gives synonyms of words spoken by the user through the microphone. It is a step forward from speech synthesis technology, which merely synthesizes speech and does not provide audio output for the words' synonyms. Meanwhile, Karajeh *et al.,* [16] stated that the use of multimedia, which combines words and images, can enhance learning. Instead of just using words, students can learn more effectively by using both words and pictures. This signifies that a mobile application dictionary that deploys multimedia potentially improves learning in students.

In addition, features in portable electronic dictionaries nowadays are improved. Students can dominate the pronunciations by hearing them from the dictionary. Besides, while reading, students can copy the text, words, or entire chunks of text, that they did not understand from social networking, e-books, games, websites, online mail, reference books, or any web page and paste them into the dictionary. As a result, mobile application dictionaries also encouraged students to read in a foreign language.

In conclusion, the mobile application dictionary is an evolution of the electronic dictionary which has gained a lot of favour as it improves learning in students. Therefore, the use of a mobile application dictionary is worth exploring and being implemented in education. Hence, it is hoped that MyBrainy Kelate will gain positive feedback from target users to help them improve their English vocabulary.

2.3 Previous Mobile Augmented Reality Applications Used in Education

Augmented reality has been used rapidly for teaching and learning purposes [17]. Past research has proven that AR can facilitate the target user in improving the prior knowledge for example [15,16,18-20]. In this section, past research on digital dictionaries and existing applications of digital dictionaries are compared and analysed. The comparison was not specified to mobile application platforms only, as the mobile application dictionary was limited. This comparison was made to find the advantages and disadvantages of the approach, the model suited for a certain type of application or a certain target user, and the result of their approach. Table 1 shows the summaries of previous studies and research on the Mobile Augmented Reality Application used in education.

Table 1
The summaries of the previous studies on the mobile augmented reality applications

No	Author & publication	Research title	Significance of study
1	Jalaluddin, Ismail, & Darmi, published in International Journal of Information and Education Technology [21]	Developing Vocabulary Knowledge among Low Achievers: Mobile Augmented Reality (MAR) Practicality	Help the struggling LINUS students regarded as Low Achiever (LA) regardless of their education level to cope with acquiring and learning the English language in the ESL context.
2	Khan, Johnston & Ophoff published in Advances in Human-Computer Interaction [22]	The Impact of an Augmented Reality Application on Learning Motivation of Students	Research on the impact of AR technology on student learning motivation using intrinsic motivation and ARCS model.
3	Astuti, Suranto, & Masykuri published in Jurnal Pendidikan Biologi Indonesia [23]	Augmented Reality for teaching science: Students' problem-solving skill, motivation, and learning outcomes	Through quasi-experimental with 56 respondents, the AR technology can influence students' problem-solving skills, motivation, and learning outcomes.
4	Abd Majid & Abd Majid published in the International Journal on Advanced Science, Engineering and Information Technology [24]	Augmented Reality to Promote Guided Discovery Learning for STEM Learning	The AR used can help the students to visualize an atom using a 3D model of atoms and video of real experiments.
5	Sunarti, Ernawati & Affan published in the Journal of Arabic Education and Literature [25]	Aplikasi Kamus ViKA sebagai Visualitator Kosakata Bahasa Arab untuk Pembelajar Pemula	The result from the research proved that the ViKA Dictionary is effective for beginner Arabic learners.
6	Pu, Abd Majid & Idrus published in the International Journal on Advanced Science, Engineering and Information Technology	Framework based on Mobile Augmented Reality for Translating Food Menu in the Thai Language to the Malay Language	ARThaiMalay translator helps Malaysian tourists understand the Thai language especially the Thai food menu.
7	Hesham Ahmed Yousif Al-Asheeri published in US-China Foreign Language [26]	Effectiveness of Using Augmented Reality Strategy in Enhancing Learning English for Cycle One Students in the Elementary Stage in the Kingdom of Bahrain	The data obtained from the testing revealed an improvement in students' performance in learning English.

3. Methodology

This research used the ADDIE Instructional Design (ID) model consists of five (5) phases which are analysis, design, development, implementation, and evaluation. Since the ADDIE model is known as a generic and traditional process that has historically been used by instructional designers and

training developers, especially because of its dynamic and flexible guidelines to build efficient training and performance support tools, it has been determined to be the best option [27-30]. Besides, the ADDIE ID model was chosen in this research because many researchers used ADDIE in developing educational projects and research [21,27]. This section discusses the method that had been adapted and the activities involved in developing the MyBrainy Kelate. Figure 1 shows the research flow that had been adapted from the ADDIE model that had been used throughout this research.
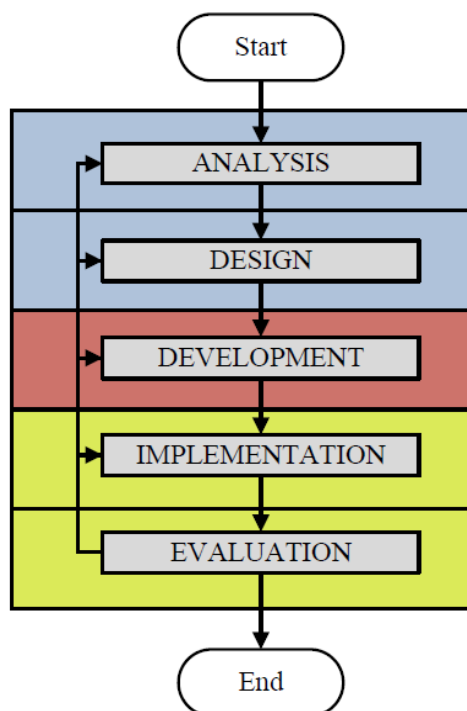
**Fig. 1.** Research flow adapted from the ADDIE model

3.1 Analysis

The main purpose of this phase is to ensure that the development of the application fulfils the research objectives. Two issues are usually raised to satisfy the requirements in the analysis phase: "What is the identified problem?" and "How the problem can be resolved?". Other than that, the target user, the user background, the potential research methodology, and the research constraint have to be identified and analysed through a literature review to obtain information concerning skills and tendencies, as well as to identify the appropriate pedagogy for adaption in the research. Other than that, a survey was conducted to identify the prior knowledge and the most difficult words for children to pronounce.

Results from the survey indicate that there is a need to help Kelantan children aged between 7 and 9 years old to translate the meaning of the Kelantan dialect into English with the right pronunciation. It is important that the children can read and understand simple English, spell in English and Kelantan's dialect, know Kelantan's dialect, and have a basic knowledge of using an application. This prior knowledge is important to use MyBrainy Kelate correctly. The survey also identified the most difficult words for children to pronounce as the content of MyBrainy Kelate. The top ten words include house, hoe, bridge, money, saw, straw, swing, brush, cupboard, and ladder. The output from the analysis phase will be the input for the next phase.

3.2 Design

The design phase is the sketching phase where the output will be visualized as visual, navigation, and interface design or application display. This phase involves the design of a flow chart, interface design, and storyboard. The flow chart visualizes the navigation or flow of activities in a form chart, the interface design visualizes the interface of each page of the mobile application, while the storyboard visualizes the overall display of the mobile application which will be developed based on the flow chart and interface design. The clear and detailed visualization of the storyboard helped the development phase. The flowchart of MyBrainy Kelate starts with the opening screen, and then continue with screen selection where the user has the option to choose 10 Kelantan's word. When the user clicks on one of the words, the next screen shows the meaning of the word in English. The user can click the AR camera button to show the AR 3D word. As shown in Figure 2, the main menu displays the logo, dictionary button, credit button, and quit button. The word screen shows the 10 words that the user can choose to display the meaning and AR 3D model of the selected word.
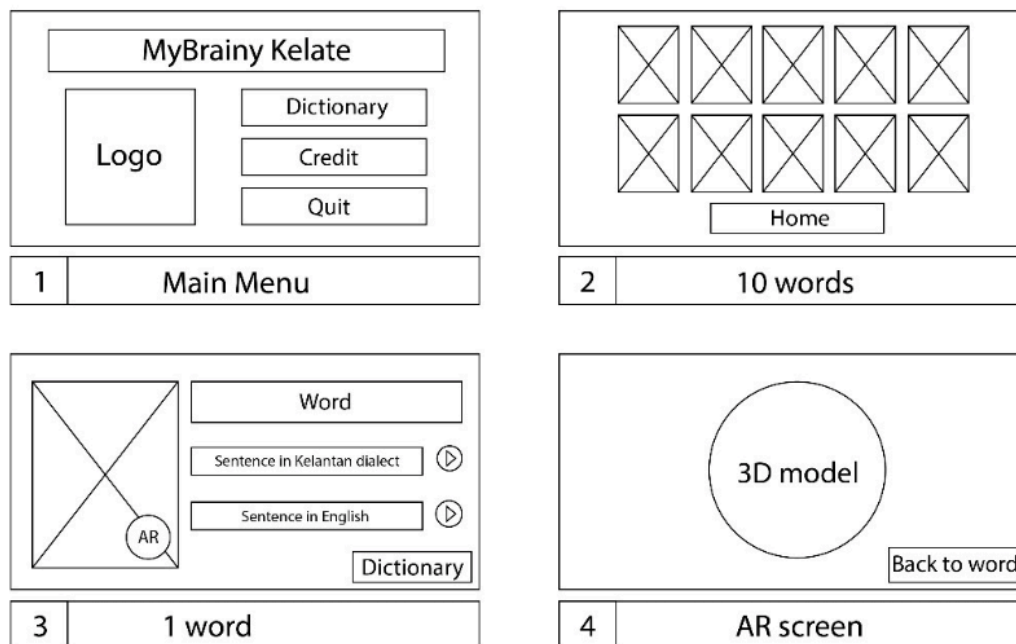
Fig. 2. The storyboard of MyBrainy Kelate

3.3 Development

The development of the mobile application was conducted in the development phase. There are two (2) activities involved in this phase which are:

i. creating the prototype
ii. quality assurance

While creating the prototype, while creating the education strategy, the types of material need to be settled. Unity 2018, Vuforia, Adobe Illustrator, and Adobe Photoshop were used to develop the mobile application. Figure 3 and Figure 4 show a part of the screenshots of MyBrainy Kelate. As shown in Figure 3, the main menu has four selection buttons: dictionary, credit, setting, and exit.

When the user selects the dictionary button, the user can choose 10 words including *dumoh, cok, grentok, pitih, ggaji, pleting, ndow, gaha, rrobok, and siga*.
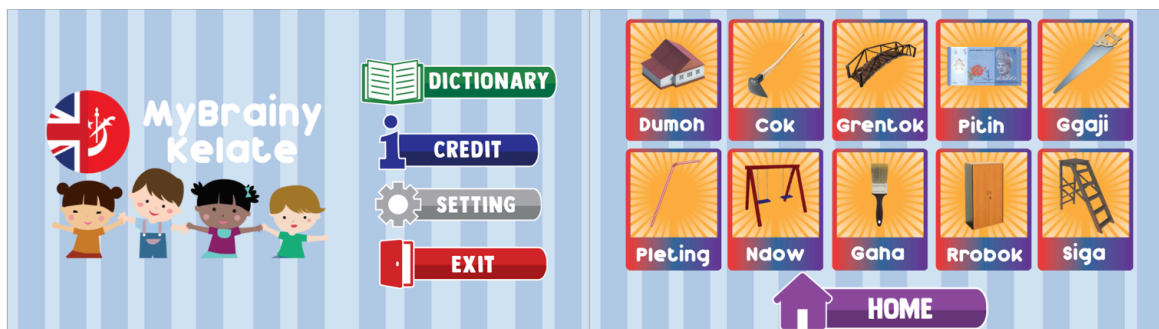

Fig. 3. The screenshot of the main menu and word selection

Each word comes with an image. Figure 4 shows the dictionary screen for the word and the AR flash card that had been used to display the 3D model.
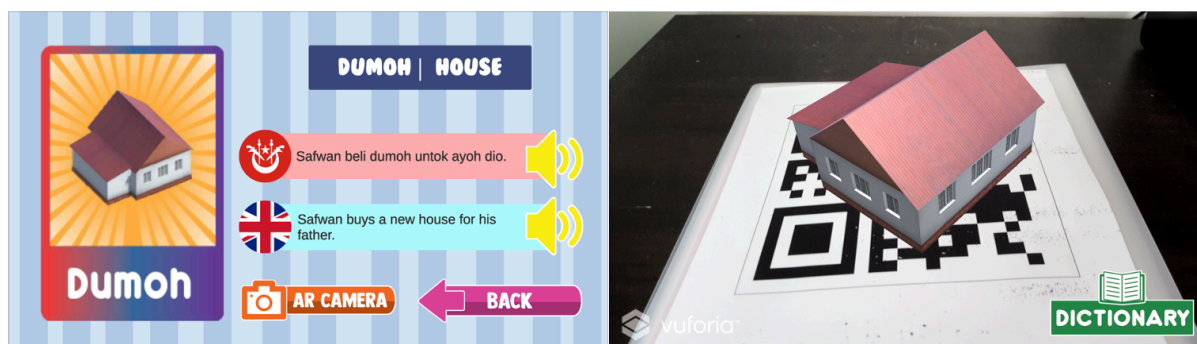

Fig. 4. The screenshot of the dictionary and AR display

3.4 Implementation

The implementation phase is an assessment of the application under development to ascertain whether it complies with the requirement specification and meets user needs. In order to find potential faults and issues that can arise during the development process, testing was done throughout the process of creating the application. In addition, the test is also will be carried out to identify if certain functional buttons and navigation issues need to be corrected before the real users have their hands on the application. As for this research, three stages of implementation will be employed:

i. application validation
ii. functionality test
iii. environment test

3.5 Evaluation

For this research, two types of testing were conducted which were usability testing and effectiveness testing.

3.5.1 Usability testing

The usability testing was conducted to evaluate the compatibility, consistency, flexibility, and learnability of MyBrainy Kelate which can be used by the end user to accomplish stated goals. Hence, a questionnaire was distributed to selected 30 respondents and the data collected was analysed using SPSS. The respondents are practitioners of Human-Computer Interaction (HCI) and multimedia who have more than 5 years of experience in the field respectively. The questionnaire was adopted from the Purdue Usability Testing Questionnaire (PUTQ). PUTQ has been used by many previous researchers to measure the usability of products and software in various fields [31]. The Likert scale was used in the questions with a range from 1 to 5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree). The respondents had been requested to use the application for around 20 minutes before answering the questionnaire.

3.5.2 Effectiveness testing

Effectiveness testing was conducted to measure the level of effectiveness among children in comprehension performance before and after using the MyBrainy Kelate compared to the conventional method. This testing utilized pre- and post-test control group designs. The objective of the pre-test is to observe the user's performance before and after using the application. Meanwhile, the objective of the post-test is to identify a significant difference between two different groups of participants after undergoing a particular treatment [32,33]. Randomly 50 children aged between 7 and 9 years old were involved in the testing. The children were divided into two groups:

i.   the control group (CG)
ii. the experimental group (EG)

Table 2 shows the number of respondents involved in the testing.

Table 2
Sample number of effectiveness testing

Group	Number of Respondents (N)
Control Group (CG)	25
Experimental Group (EG)	25

During the pre-test, using the existing knowledge that had been taught in the class by the teachers, both CG and EG groups of students were asked to answer a set of comprehension questions with assistance from a teacher. The marks from the questions were then recorded. After completing the pre-test, again, students in CG had been taught the same knowledge about the vocabulary words same activity as in the pre-test. Meanwhile, students in EG were given the MyBrainy Kelate application. They had been given 15 minutes to play and explore the application freely. The students in EG have experience using the smartphone or tablet owned by their parents or family members. After that, the students in all groups were asked to answer the same questions as the pre-test, but in a different order.

4. Results

4.1 Usability

Figure 5 presents the results of usability testing for each element with mean scores. Based on the results, the highest mean score for usability testing comes from compatibility (4.32) followed by flexibility (4.11). Meanwhile, the mean scores for learnability and consistency are 3.98 and 3.89 respectively. The results further showed that the overall mean score of the usability elements is 4.08, which is considered high. From the evaluation, the majority of the users strongly agreed with the aspects of compatibility, consistency, flexibility, and learnability of MyBrainy Kelate. Thus, the objective of the project which is to evaluate the usability of MyBrainy Kelate among target user is accomplished and the mobile application meet all usability requirements tested.
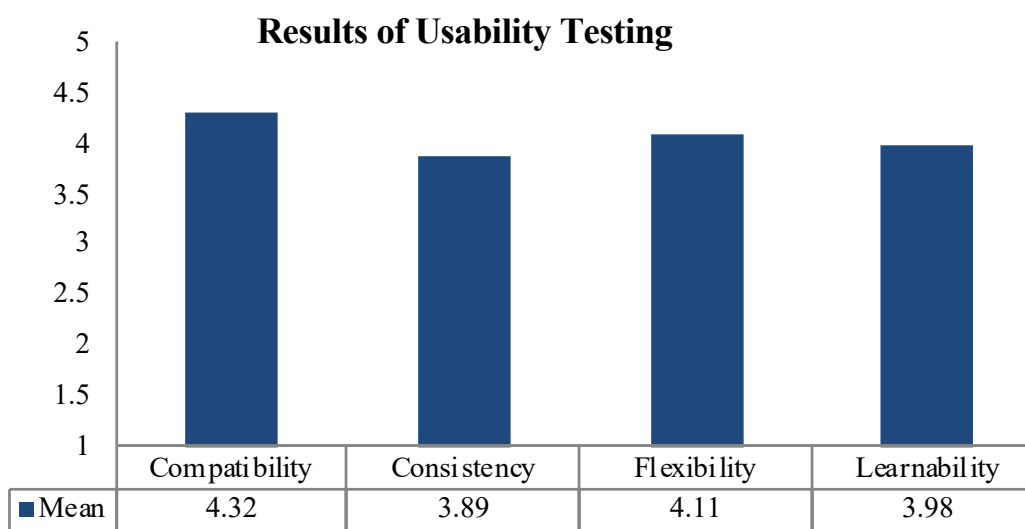

Results of Usability Testing

	Compatibility	Consistency	Flexibility	Learnability
■ Mean	4.32	3.89	4.11	3.98

Fig. 5. Results of usability testing

4.2 Effectiveness

The differences in pre-test and post-test scores among users were tested through a t-test. Table 3 shows the results of the t-test that was carried out to examine the effectiveness of the MyBrainy Kelate based on user achievements before and after using the application. Based on the table, the mean score of the pre-test score is 5.90 (SP = 1.2134) and the mean score of the post-test score is 8.43 (SP = 0.8137) for the number of N= 25 users. The test results gave a value of t = -10.124 and p - 0.000 (p<0.05). This means there is a significant difference in users' achievements before and after using the application. The effectiveness of this application is when there is an improvement in the user's knowledge where the user can receive and understand the knowledge and information about the English vocabulary that is presented in the application.

Table 3
Result of t-test for pre-test and post-test

Test	N	Mean	Standard deviation	t-value	Sig. p
Pre-test	25	5.90	1.213	-10.124	0.000*
Post-test	25	8.60	0.814		

* Significant at the p <0.0005

5. Conclusions

The main contribution of this research is the AR mobile application Kelantan Dictionary called MyBrainy Kelate for primary school to improve English vocabulary. MyBrainy Kelate will help primary school students especially 7 and 9 years old who have difficulties translating Kelantan dialect words into English words. The MyBrainy Kelate consists of a combination of multimedia elements which are text, graphics, audio, and navigation. The methodology used in this research can be used as a guideline for mobile application developers to develop AR mobile applications for other dialect languages. Generally, MyBrainy Kelate has been successfully developed according to the plan that has been made. It fulfilled the research objectives and research questions. MyBrainy Kelate has successfully complied with the usability standards, according to the usability tests. The application is a useful tool for users to increase their vocabulary and understanding of English, as evidenced by the effectiveness of testing results. The results also proved that the usage of technology-based learning can help the user improve their knowledge and understanding of certain topics or problems.

However, there is still plenty of room for improvement with this mobile application, it can assist Kelantan's children in learning English and standard Malay words more effectively. In future works, some ideas can be implemented in the application. The application can become more interesting with the implementation of gamification elements including the gameplay, game goals, game rules, and game storyline. To assess the application's playability, playtesting can be done using playtesting heuristics evaluation.

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