A Mobile Gamification English Vocabulary Learning System for Motivating English Learning

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Abstract: *English learning in Nigeria has become imperative and its continuous learning cannot be waved, since it is the official language in Nigeria and an international language for communication. Despite the importance of English language, student's performance in English language in Nigerian secondary institutions has been discouraging. Research has shown that vocabulary is the most important element of any language learning including English language. This paper implemented a mobile gamification learning system for motivating learners to continue learning English vocabularies effectively on mobile devices. The system was evaluated, through an online survey, which was completed by 71 participants with different English vocabulary level abilities. Experimental results revealed that the developed system significantly improve learner's English vocabulary abilities and learning interests.*
Keywords: English, Motivation, Gamification, Experience point gap, Mobile learning, Vocabulary, Badges, Rewards.

I. Introduction

English Language is a foreign Language to Nigeria in the sense that it is not indigenous, but it is used in Nigeria as the official language. It has played a major role in Nigeria which could be seen in our education, government, business, commerce, mass media and most of internal and external communication. Formal education in Nigeria today is a product of English language. Without English, there is the possibility that there may not be anything more than the elementary formal education in Nigeria [5]. Excellent vocabulary knowledge is needed to understand the meanings of an English sentence or article. In recent years, a lot of researchers made efforts in the study of English learning, and most studies emphasized the importance of vocabulary learning to English learning [9]. Many researchers also pointed out that the major challenge for English learning is to face entirely new and unfamiliar words that appear in an English text. In order to read English texts fluently and smoothly, a learner needs to at least, memorize two thousand commonly used English vocabularies [24, 21,11]. It is obvious that vocabulary learning is very essential to English-language learning acquisition. It is common knowledge that classroom teaching time is limited and there are so many components involved in English language learning (listening, reading, writing and speaking activities), so teachers seek alternative ways to help students learn vocabulary. Mobile learning is one of such alternatives. Some recent studies have shown positivity in the use of mobile phones to teach vocabulary, either through SMS (Short Message Service), messaging, emails, and also social media networks such as twitter and Facebook. It considered that using a smartphone is effective for independent learning such as English vocabulary memorization, because a learner can use the smartphone anytime and anywhere [26,1].

II. Gamification And Motivation

Motivation is very important in learning. It has been observed that if students are not motivated, they may not be able to solve a problem, even though they have the skills to solve it. On the other hand, if they are highly motivated, even though they have limited ability, motivation will help them find a way to solve a challenge and also improve on the skills. However, according to [12], motivation and ability alone are not enough. A 'trigger', which is like a call for action, is also required so as to tell the user to achieve a certain behavior. Software mobile applications can serve as such 'trigger' to change people's attitudes and behaviour [10,13]. Gamification has been shown to engage and motivate learners when used properly in or outside the classrooms [18, 23]. Gamification combines both Intrinsic and Extrinsic motivation to raise user engagement and also influence their behaviour towards learning. Intrinsic motivation is an internal desire to perform a task and results in high-quality learning and creativity while Extrinsic motivation occurs when external rewards not related to the task itself drive the user to take an action, for example, money, good grades and awards [25]. Lepper [19] explained that when people are intrinsically motivated, they tend to take an activity for their own sake, for the enjoyment it provides, the learning it permits, or the feeling of accomplishments it evokes. On the

other hand, people become extrinsically motivated is to obtain some reward or avoid punishment. The use of game elements increases students' motivation because they get fully engaged when faced with a challenging task. For example, by using extrinsic rewards like levels, points, and badges to improve engagement while intrinsically motivating towards the achievement, mastery, autonomy, and sense of belonging.

III. Related Work

A lot of researches have been conducted on English vocabulary learning and different systems have been developed, but most of these systems were developed on PDAs (Personal Digital Assistant) with very few designed to sustain learner's motivation. However, PDAs are now expensive and almost out of existence as they are being replaced by smartphones. Two of the most documented English vocabulary learning system on smartphones for sustaining learners' motivation were implemented by Hasegawa et al. [15] and Lam [17]. Hasegawa et al. [15] developed an effective vocabulary learning support system for the learner's sustainable motivation. The system employed gamification techniques and functions to motivate learners to continue learning; however, the system functions and menus were written in Chinese language, with no translation option provided, thereby making it not suitable for non-Chinese speaking persons. Also, the system only focused on basic or elementary level of vocabulary as the learning material, ignoring other levels such as intermediate and high-intermediate.

Lam [17] described the use of gamification in Vocabulary Learning: This was to determine if online games could help motivate students in English vocabulary learning in the classroom and as such, two online games were used. It was established that online games improved the vocabulary learning attitude of the participants. The research still presented a few limitations. One of such is that the learning procedure was restricted to classroom learning alone and also the learning materials were obtained from the students' class notes, thereby making it impossible to learn outside classroom environment. Other works include; Huang et al. [16]) developed a ubiquitous English vocabulary learning system. The system is a ubiquitous English vocabulary learning (UEVL) system, designed to assist students in experiencing a systematic vocabulary learning process. Yuksel and Sevil [28] implemented a learning Environment for English vocabulary using Quick Response Codes. A learning environment that uses tablets and Quick Response (QR) codes to enhance participants. Unlike other ubiquitous learning technologies, study reveals that Quick Response codes have the potential to increase the mobile devices' effectiveness level due to their being flexible tools for obtaining knowledge and promoting individual learning and low cost. Chen and Li [6] presented a personalized context-aware ubiquitous learning system for supporting effective English vocabulary learning. The development of context-awareness system, which can support learners in English vocabulary learning without constraints of time or place via mobile devices in real learning environment. Chen and Chung [7,8] developed a personalized mobile English vocabulary learning system based on item response theory and learning memory cycle. The system recommends appropriate English vocabulary for learning according to individual learner vocabulary ability and memory cycle. Since English learning has been the most important second language in non-English speaking countries, developing modern assistive learning forms or tools that support effective English learning has been a crucial issue in the English-language education field. Guoliang et al. [14] presented a research on Mobile English Assistant Learning System based on Wireless Communication. It is an English mobile learning system based on Bluetooth technology. With the characteristic of portable devices, the system was designed for low power consumption and low learning cost. With the help of the system, a teacher could receive instant feedback from the students. This research adopted the use of Gamification mobile learning system to encourage learners to continue learning English vocabularies effectively.

IV. System Design

In this section, the design of a gamification-based English vocabulary system for improving English vocabulary abilities of learners is presented. Details of the system architecture include; the English vocabulary learning procedure, extraction of learning materials, Gamification function used and difficulty level adjustment. The architecture of the system is presented in Figure 1. The system consists of three major modules, with a database, and a learning interface. The modules are the vocabulary recommendation module, learning performance assessment module and test module
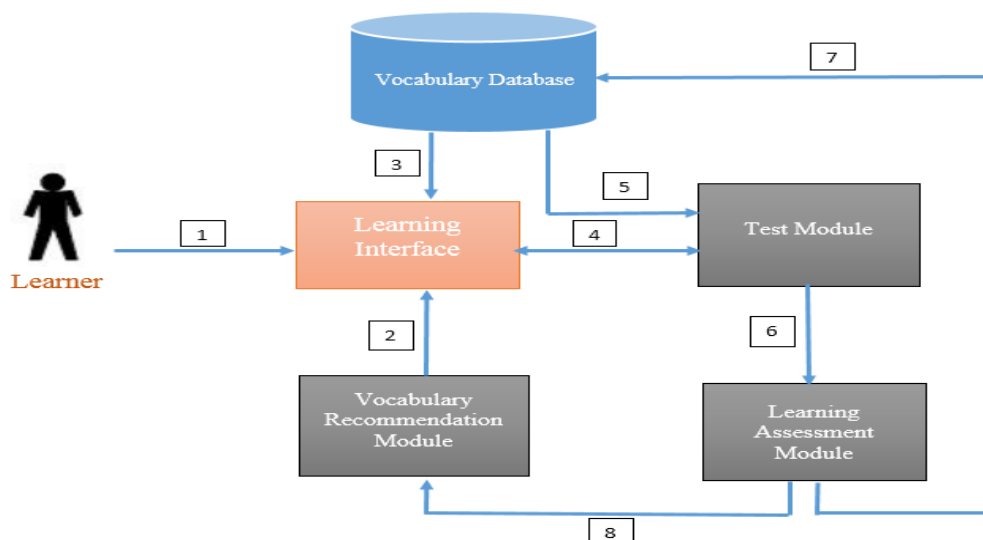
Fig. 1. Architecture of the System (Adapted from [7])

The vocabulary recommendation module**:** The module recommends English vocabulary to individual learner according to the game level of the individual learner (game level). The test module**:** This module automatically generates a corresponding testing sheet according to the learned vocabularies of individual learner for assessing the learning performance. The learning performance assessment module: This module collects the learner test results from the test module, then re-evaluates individual learner ability of vocabularies. This is where gamification comes in. Each test questions generated by the Test module has points attached to them. These accumulated points are what is used by the learning performance assessment module to progress a player to a new level based on the difficulty level adjustment model. The learning performance assessment module, then stores these information mentioned-above in the user portfolio database for personalized English vocabulary recommendation learning. All the English vocabularies stored in the vocabulary database are from the repository of Graduate Record Examination (GRE). The system applies the grading level of GRE to categorize each vocabulary into different game levels. The GRE is divided into three levels with content appropriate to each level; Basic, Intermediate and Advanced levels. These levels are further subdivided into ten (10) game levels. The Basic level vocabularies forms the first three game level, while the Intermediate level vocabularies form the next three game levels and the Advanced level vocabularies forms the last four game levels. The system consists of a total of 500 vocabularies and 600 test questions.

The system operation procedure is summarized as follows:

Step 1. Learner logs into the system through the learning Interface. The learning Interface checks the individual learner's profile. If learner is a beginner, it requests for the learner/player to create a profile. The learner starts the learning process.

Step 2. The vocabulary recommendation module obtains the game level of individual learners and all learned vocabulary from the vocabulary database.

Step 3. If a learner is learning for the first time, the vocabulary recommendation module then recommends new vocabulary to the learner.

Step 4 and 5. The test module then checks the vocabulary database for questions related to the learned vocabularies and presents it to the learner as game tasks or challenge

Step 6 and 7. The learning performance module assesses the result from the test agent and increases the learner's game level using Experience points gained in a previous level. It then stores this new information in the vocabulary database.

Step 8. Learner returns to Step 2 to perform the next learning cycle or quit the game, thereby terminating the learning process.

A Gamification model was adapted from [22]]and it consists of;

a) A set of tasks k ∈ K that need to be performed
b) A set of game design elements g ∈ G, where G is gamification
c) A set of users u ∈ U processing task K enhanced by G, where U is the total number of users.

A. Gamification Functions

The gamification function is designed referring to the digital game-based learning framework proposed by Tan et al. [27] which can be utilized to fulfil the system concept that encourages learners' motivation to learn in

mobile learning environment. Tan and others proposed a framework in which an educational game was composed of three elements; Multimodal, task and feedback. Multimodal refers to a variety of interaction that connects a learner and a game, namely, sounds, animations, effects etc. Task refers to a question or problem in the game to help learner to absorb the learning content (i.e., English vocabulary word with appropriate difficulty that adjusts to learner's skills in this case). Feedback for learners is vital in an educational game. A suitable feedback reduces the learner's misunderstanding.

B. Difficulty Level Adjustments

Gaming experience begins with tasks or missions that should have clear goals and provide immediate feedback. These goals should be both challenging and achievable, thus giving rise to various conflicts and challenges. Too much challenging goals will not be achievable, and easily achieved goals will not be challenging. Some players will lack the enthusiasm to engage with too difficult or too easy missions, while some others will classify them as not enjoyable. Ideally, game challenges should increase when the player advances in levels. As the player becomes more proficient with the game and his/her character becomes tougher, the amount of experience or any other metric needed to advance a level should be more than the amount needed on the previous leveling up [2,3]. Similar techniques are applied in almost all Role-Playing Games (RPGs) to adjust the experience point gap for leveling up automatically [4]. The formula is given as:

$$T_{XP}(N) = T_{XP}(N-1) + (P_2 * C_L)$$
where, N = New game level
$T_{XP}(N)$ = Total Experience points for progressing into level N.
$T_{XP}(N-1)$ = Total Experience points gained in the previous level.
P_2 = Experience points needed for progressing from level 1 to level 2 which is predetermined
C_L = Current game level.

The formula above is used by the system to calculate the total experience point that is needed for progressing to a new level. The learning Assessment module then compares the score that a particular user gets from solving a task/test question in particular level with the total experience point that is required to move the user from his current level to a new level. If the user's score equals the total experience point, the user is progressed to the new level or else the user remains in the same level and retakes the learning process for that level.

C. System Implementation

This section explains the implementation of the English vocabulary learning system. Currently, all client-side program code is implemented using HTML5, CSS3 and JavaScript. The server-side scripts were implemented using PHP 7.0 (Pre-Processor Hypertext Processor). The backend i.e. database, was implemented using MySQL. Other tool includes; Website2apk converter (Android Mobile application software development tool). The system is available as a mobile web application and also as an android application. Figure 2 shows the login page.
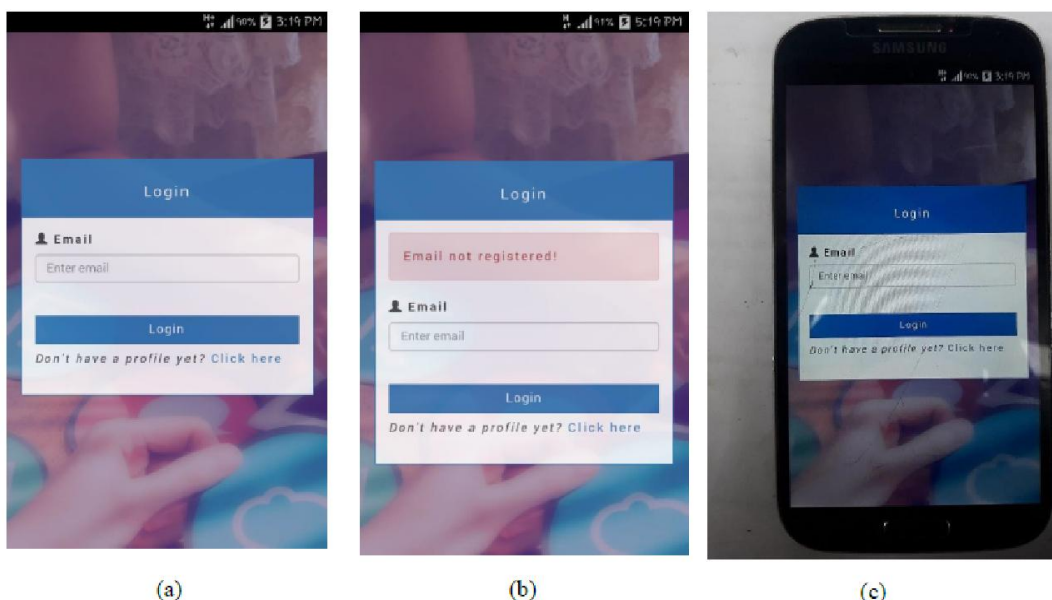

(a)   (b)   (c)

Fig. 2. Login page

After successful login, the user is taken to the learning page shown in figure 3, which contains the vocabularies to be learnt, a NEXT and PREVIOUS button for navigating through the vocabularies. The top-right corner contains boxes for the player level and the player score. Also, attached to each vocabulary, is a speaker button. This button, when clicked, pronounces the corresponding vocabulary and its meaning. When the last vocabulary for a particular level is reached, the NEXT button changes to TAKE TEST button (see figure 3). This button is used to navigate to the test page for the user to answer the test questions relating to the learnt vocabularies as seen in figure 4. The top-left corner shows a side bar button, navigation menus such as, Profile, Leaderboard, About and Logout. This side bar button is consistent on all other pages in the application. This page allows users to take test relating to the learnt vocabularies. When a user clicks the TAKE TEST button from the learning page, the system opens a pop-up containing instructions about the test to be taken for users to answer. The test consists of ten questions and four options which are loaded one per page and also presented at random to the user. On answering each question, the user is shown if each selected answer is correct or wrong via a pop-up alert and a progress bar (Figure 4). If the user answers all the questions in a particular level, the system moves the user to the next level and a badge is earned (see Figure 4i) else the user remains on the same level
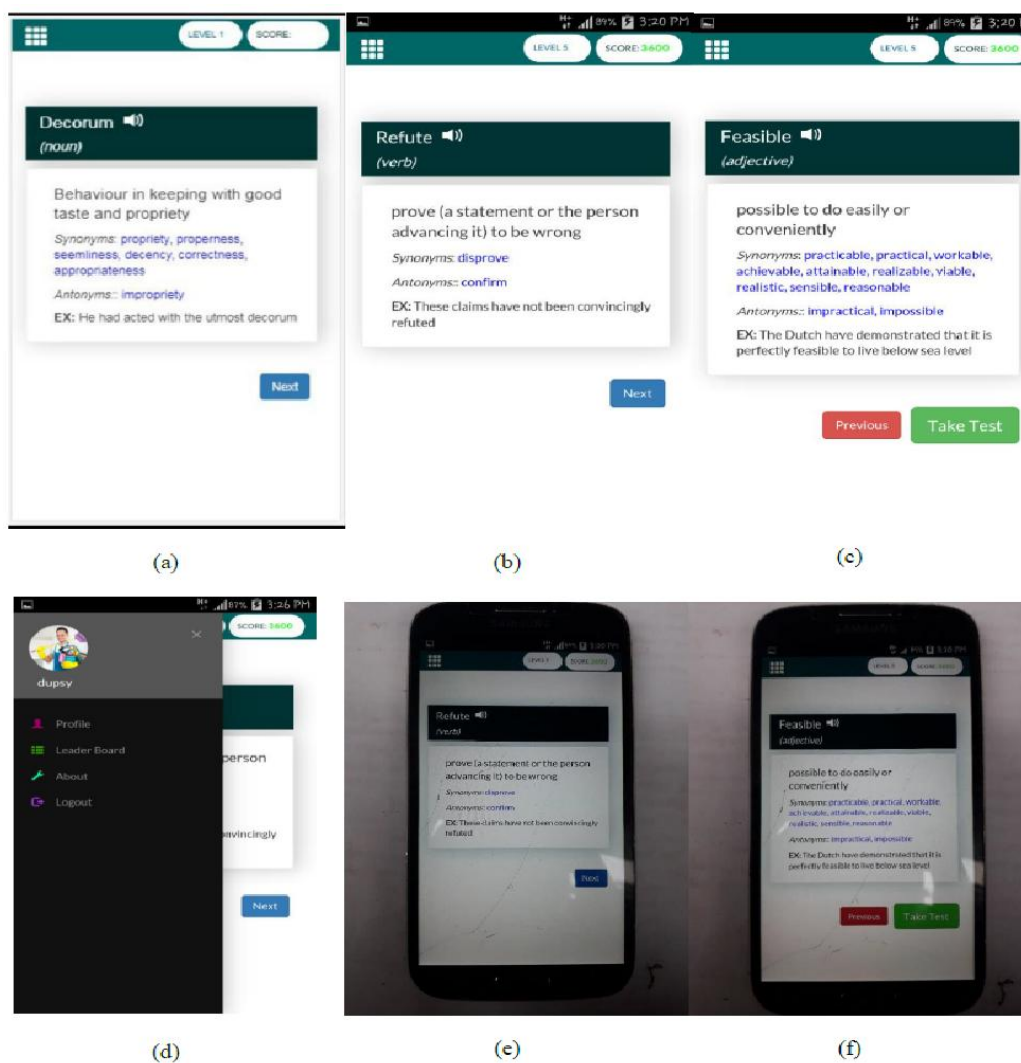
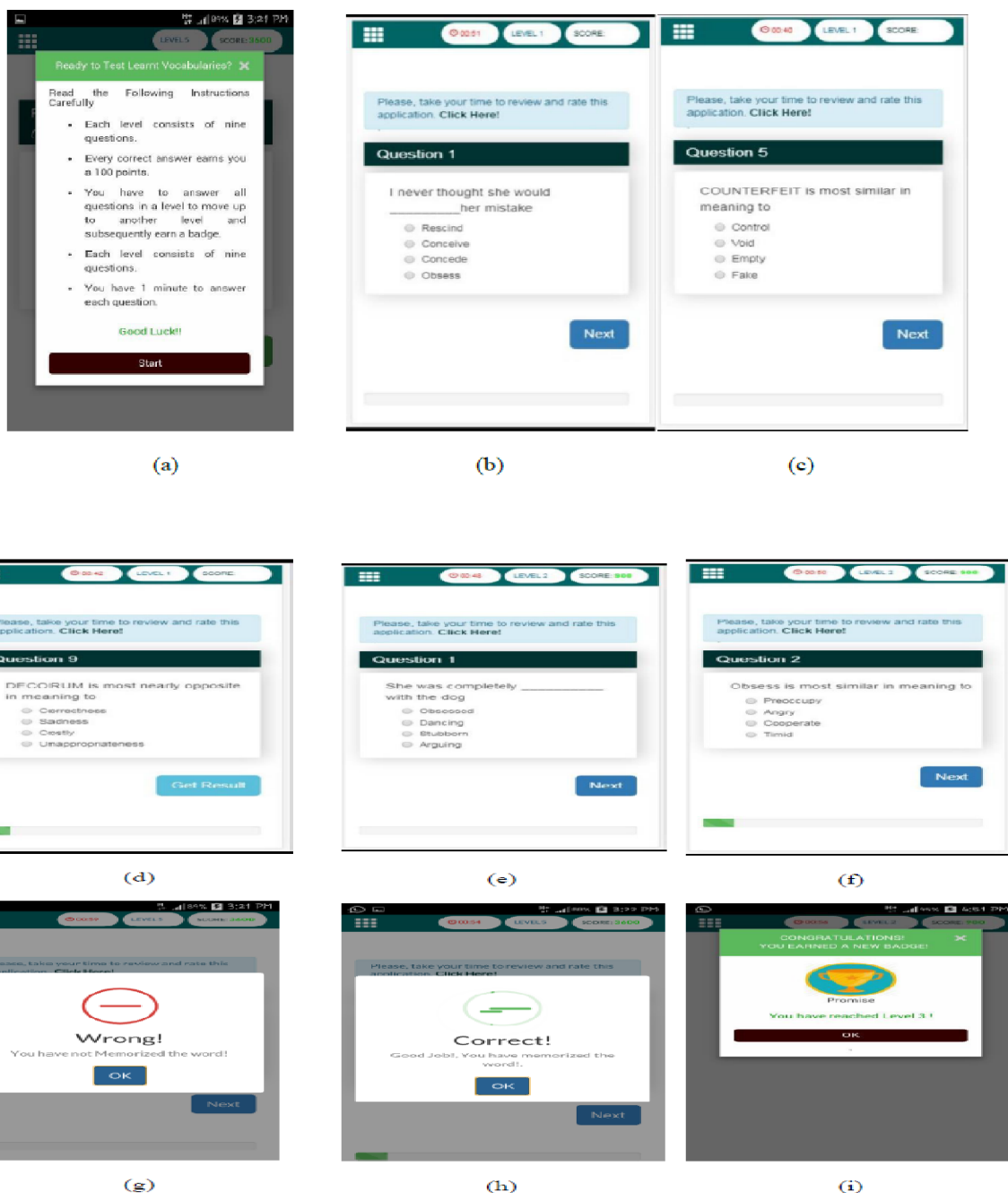

Fig. 3. Learning page

Fig.4. Testing page

Figure 5 shows the result of the test taken by a user. It contains information like the total questions for a particular level, number of correct answers, number of wrong answers and the player's score. It also contains buttons for replaying a particular level and also for reviewing test question for a particular level.
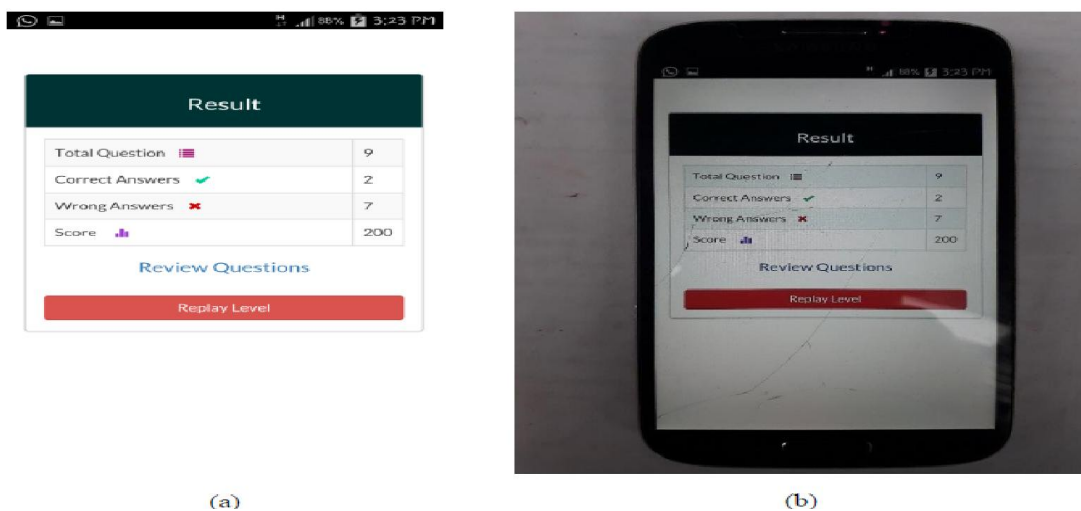
Fig. 5. Result page

Figure 6 shows information about a user. This information include input supplied by a user during registration, such as player name, email address, and profile picture. Also, it contains information about the user progress such as, user level, score, badge earned in the current level, achievement. Lastly, it contains buttons for editing user profile.
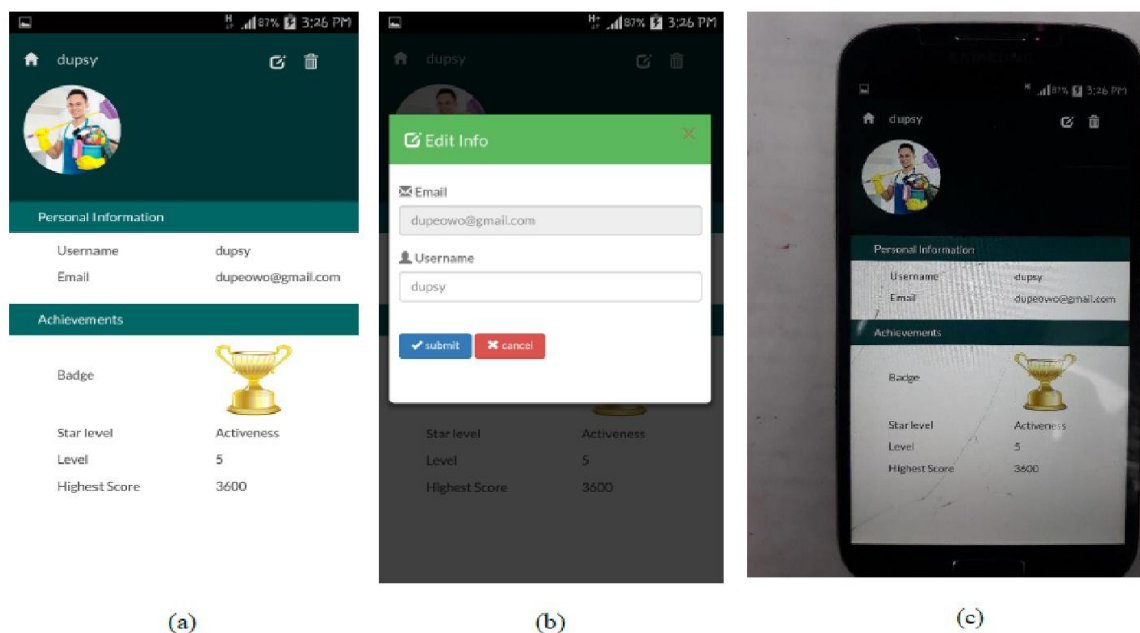
Fig. 6. User profile

The leaderboard page shows the list of users with top five high scores. This page is aimed to motivate the user to keep learning through the application by wanting to be part of the top five scores in the system. The Leaderboard page is depicted in Figure 7.
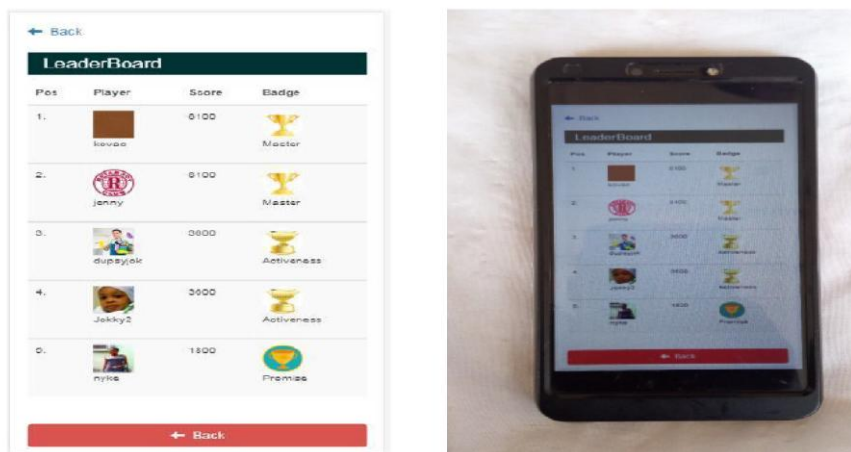
Fig. 7. Leaderboard page

V. Learning Scenario For Mobile Gamification English Vocabulary Learning System

A scenario of the learning process is presented here. A sample user with username "Jonny" is a new user with low English vocabulary ability and he wishes to use the developed application to learn and improve his vocabulary ability. Jonny logs into the system with his registered email address and the learning page is presented to him, containing a side bar and the first vocabulary to be learnt at the first level (level 1) as shown in figure 8. The user starts from level 1, he has no score and badge yet, till he progresses in the game. The vocabulary word "Concede" is first presented to the user with its meaning, synonyms, antonyms, example sentence and a speaker button to listen to the word pronunciation. When Jonny clicks the "Next" button, he's presented with another word, till he reaches the last word to be learnt on level1 (see Figure 8).
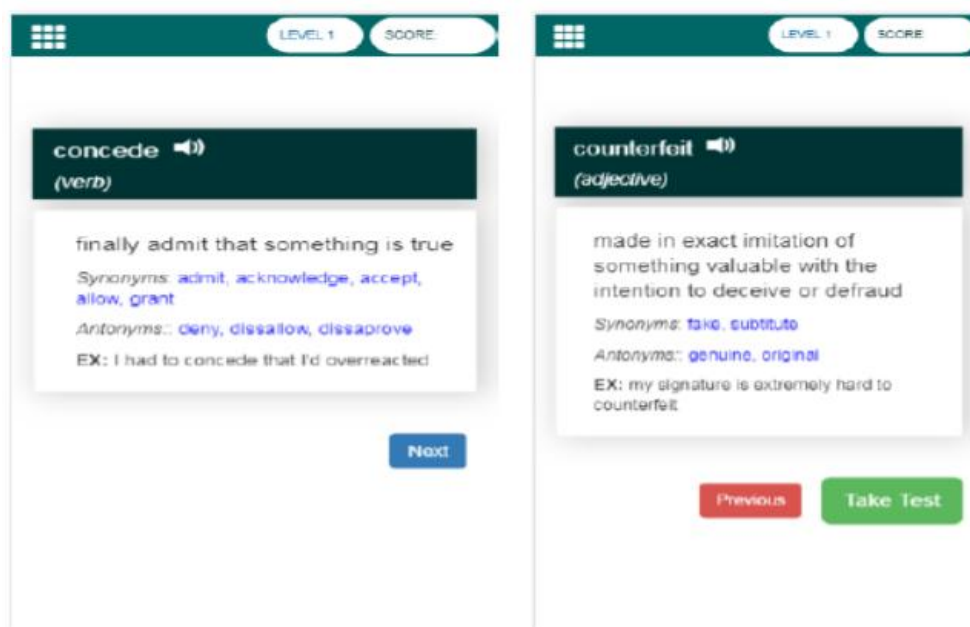
Fig. 8. Jonny learning vocabularies at level 1

On clicking the "Take Test" button, the user is taken to the test page where he is first presented with instructions on taking the test (see Figure 9) and then, questions related to the learnt vocabularies presented to him so as to test his memorization ability. The first Question is about the vocabulary word "CONCEDE" (see Figure 8) which has been previously learnt on the learning page. Four options are provided for the user from which he selects a correct answer. If Jonny gets a question right, a feedback is shown to him to notify him that he got it correctly (see Figure 9c) and if he gets it wrong a feedback is also provided for that (Figure 9e). As Jonny clicks the Next button, the next question, which asks about the synonyms of the word "CONCEDE" is provided for him to answer (see Figure 9d). On getting to the last question, the "Next" button changes to "Get

result", which when clicked shows the result of the test Jonny (see Figure 9g). The results consist of information such as, Number of correct answers, Number of wrong answers, score, and Total number of questions (as shown in Figure 9g). If Jonny answers all questions in level 1 correctly, he earns a badge and moves to level 2 (see Figure 9i) else he remains in level 1 and earns no badge (Figure 9h).
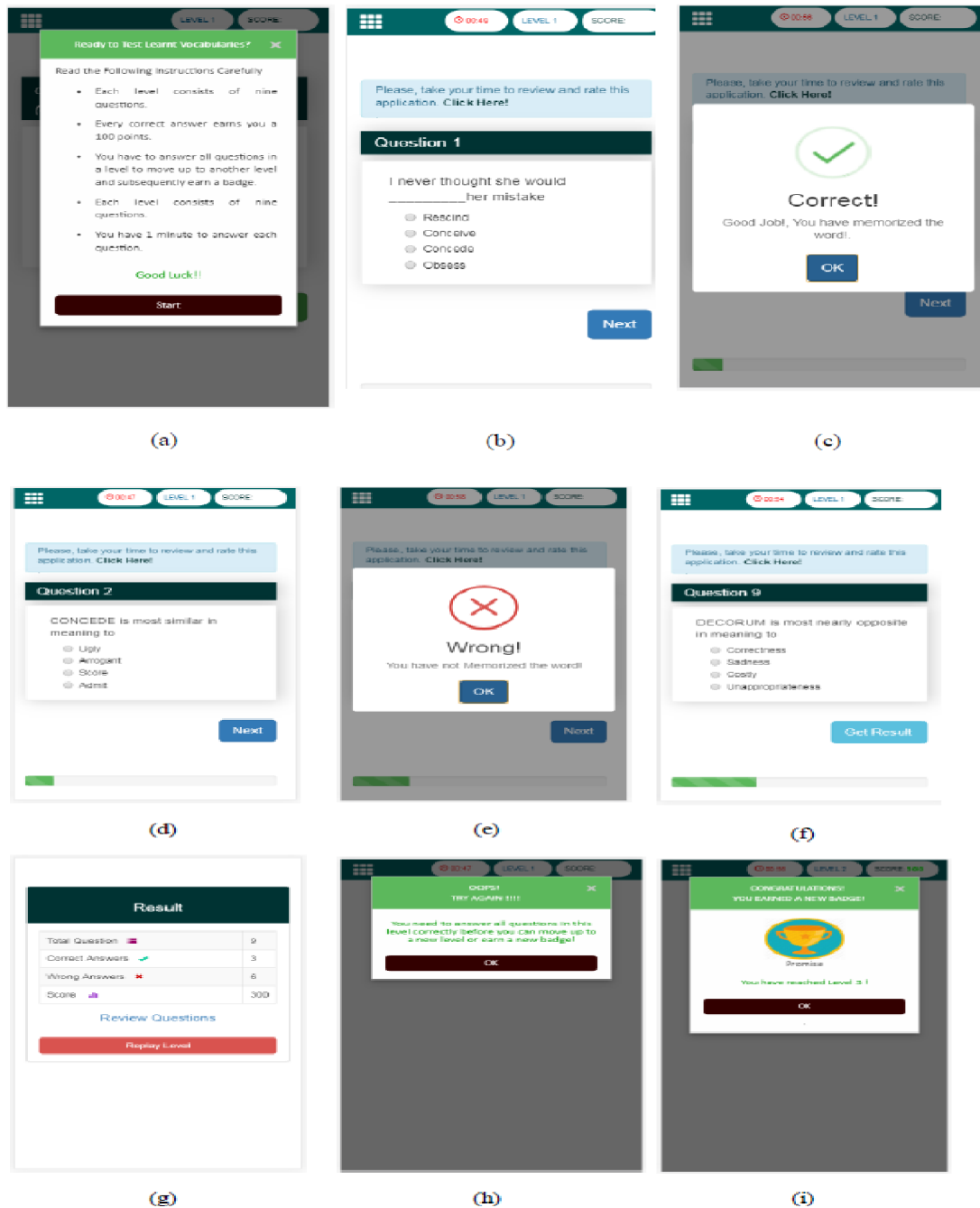

Fig. 9. Jonny taking a test at level 1

Since the user undergoes the same learning process for all the levels in this application, only few game levels such as; level 1, level 7 and the last level (level 10) are depicted in this scenario. At level 7, Jonny is presented with the vocabulary word "PANDEMONIUM" (see Figure 10(a)), "FLABBERGAST" (see Figure 10(b)), and "REPLICA" (see Figure 10(c)), with their details.
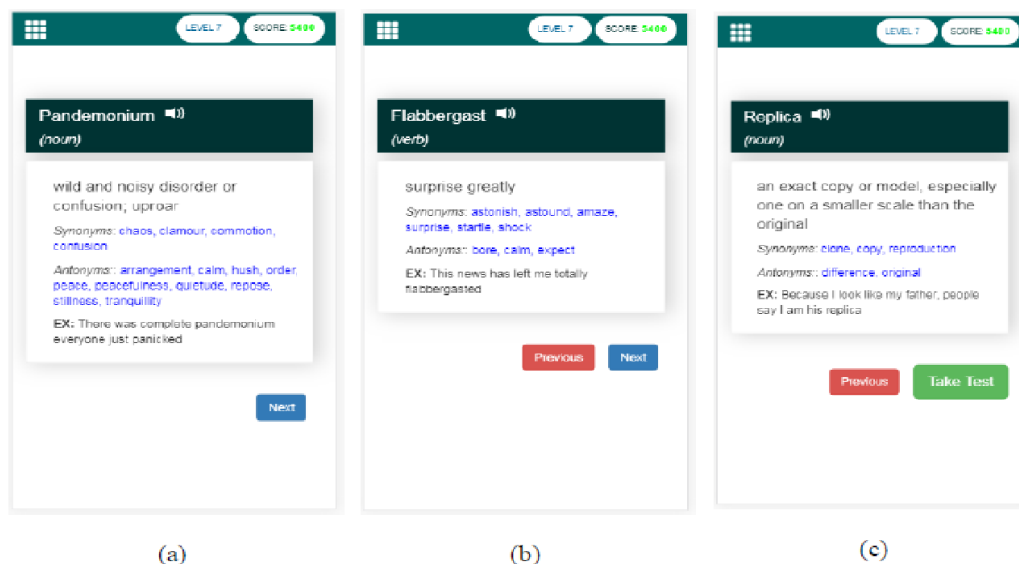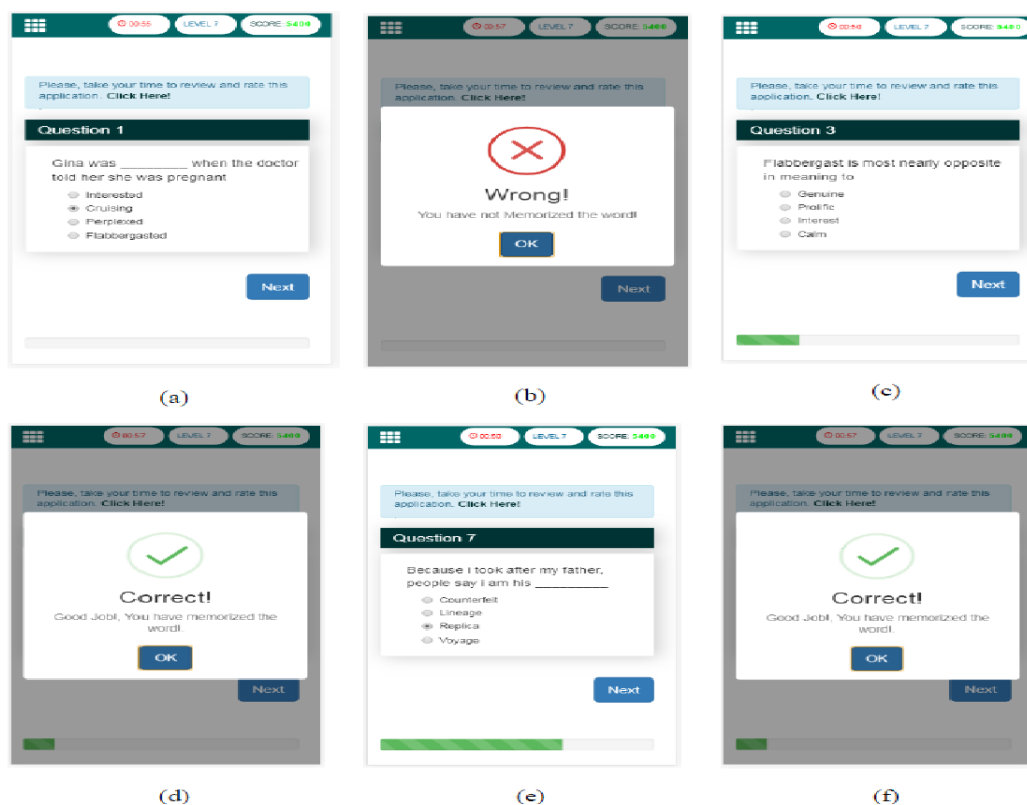
Fig. 10. Jonny learning at level 7

After Jonny is done learning the vocabularies, he clicks the "TAKE TEST" button and then is taken to the test page. The first question presented to him is on the vocabulary word "FLABERGAST" (Figure 11(a)). Figure 11(b) shows the feedback when he selects a wrong option while answering the question. Question 3 (see Figure 11(c)) asks about the antonym of "FLABERGAST". Figure 11(d) shows a feedback that Jonny got the answer to question 3 correctly. Also, question 7, which is on the vocabulary word "REPLICA" is depicted in Figure 11(e) and a feedback that the user answered it correctly is also shown in Figure 11(f). The result of the test taken by the user at level 7 is shown in Figure 11(g). The result shows the number of correct answers he got, number of wrong answers, total number of questions and his score. Finally, a feedback to show that Jonny failed to progress to the next level is shown in figure 11(h) and on subsequent attempts, he finally progresses to the next level (see Figure 11(i)).
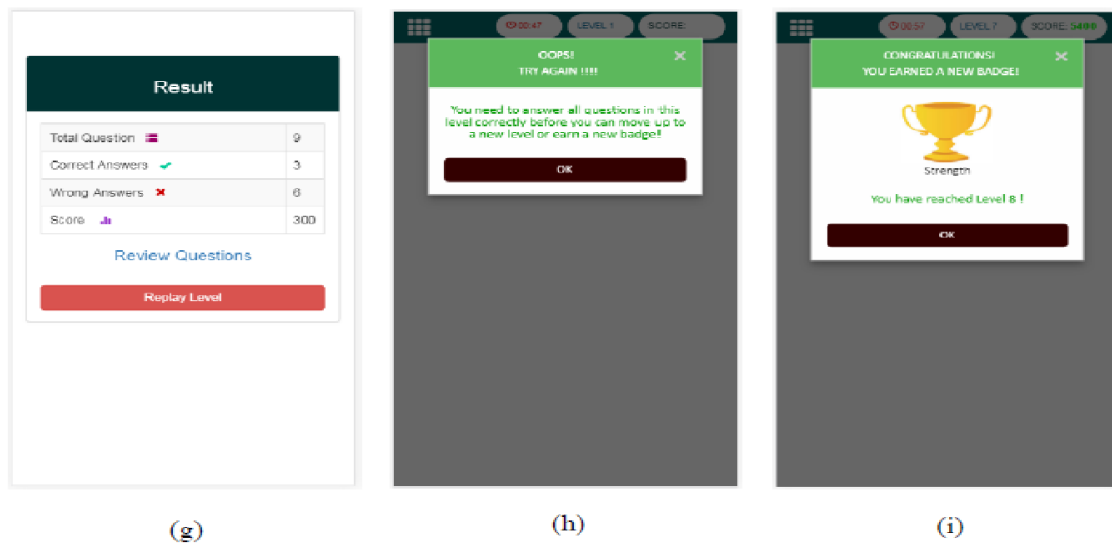
(g) (h) (i)

Fig. 11. Jonny taking a test at level 7

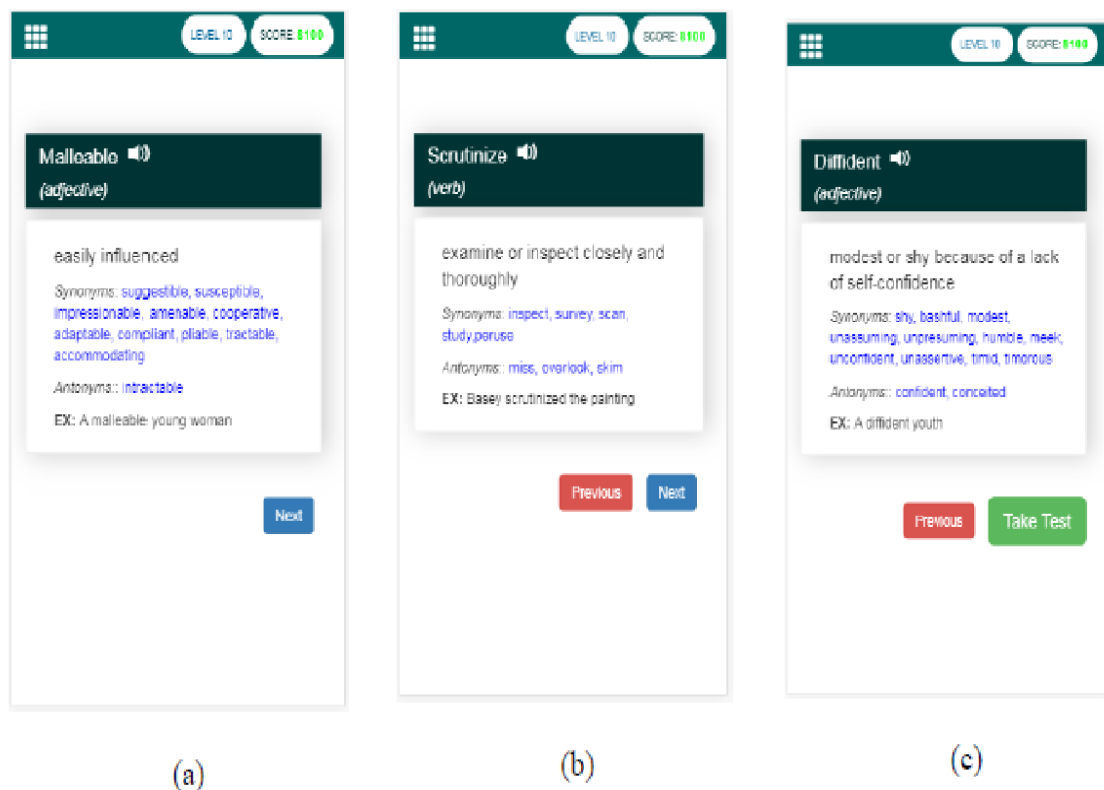On reaching the last level (level 10). Jonny is first presented with the vocabulary word "Malleable" see figure 12.

(a) (b) (c)

Fig. 12. Jonny learning vocabularies at level 10

Next is the word "Scrutinize" and another is "Diffident". After completing the vocabularies learning, he then proceeds to take a test on the learnt vocabularies. Some of the questions presented to the user at this stage, with their appropriate feedback is shown in Figure 13(a), 13(b), 13(c), 13(d), 13(e), and 13(f). The result is shown in Figure 13(g). Because the user took the test on the last level, if he answers all questions correctly, he will not move further to a new level, instead, a feedback that shows he has successfully completed all levels in the game is presented to him, as shown in Figure13(h).
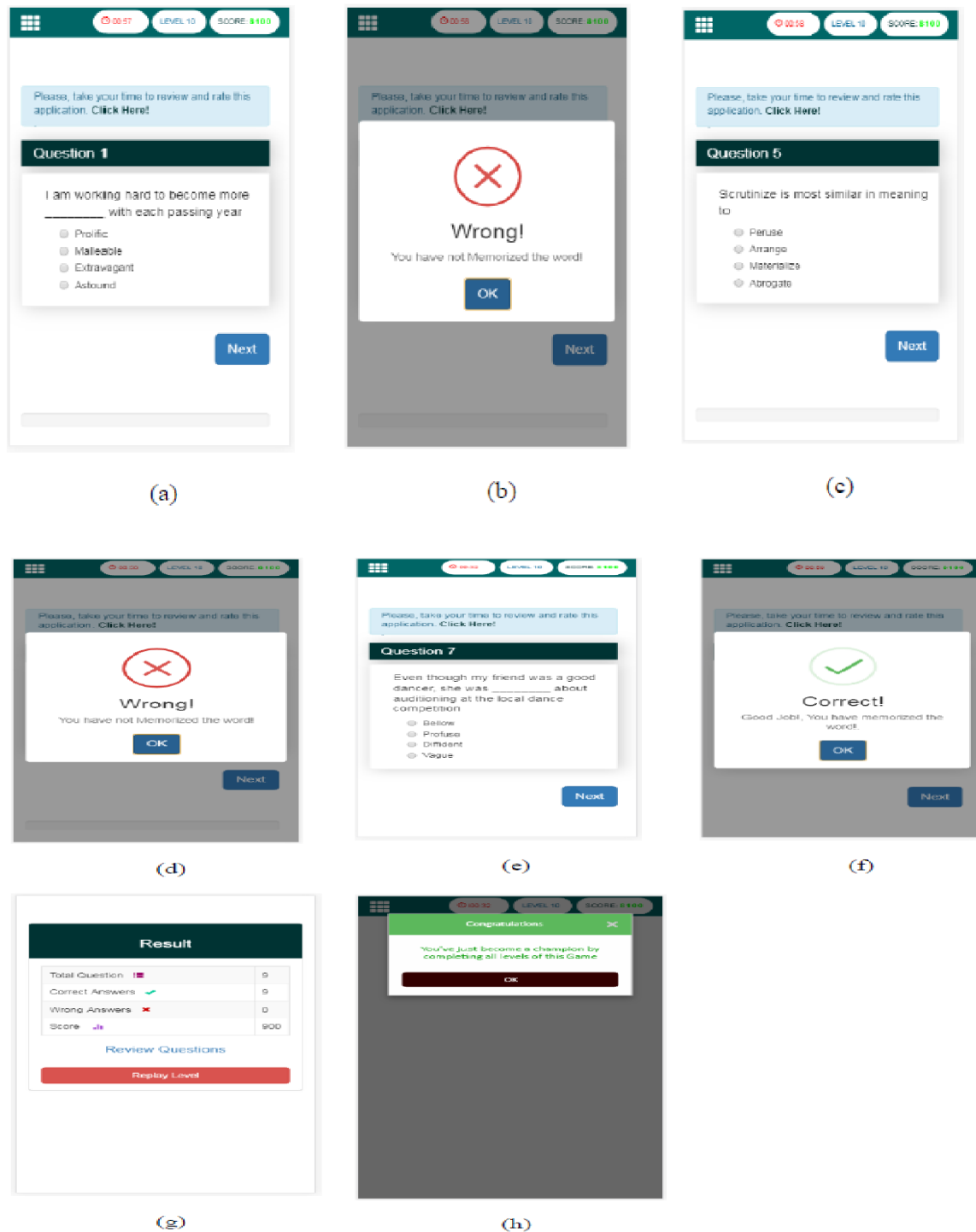

Fig. 13. Jonny takes a test at level 10 (last level of the game).

VI. Application Evaluation

The evaluation and effects of the system was carried out through actual use and a survey form attached to the developed application (see figure 14). The survey was completed online by 71 participants, consisting of 41 Males and 30 Females. The participants used different vocabulary level ability (i.e. Basic, Intermediate, High Intermediate level). The participants answered the survey for each function on a scale of five, three and one. Five is allocated to "Agree", Three is allocated to "Neither agree nor Disagree", and one is allocated to "Disagree". The content of the survey and its result is shown in Table 1 below. Figure 15 shows the Graph of the survey performance.

Fig.14.   Online survey form

Content	Agree	Neither Agree nor Disagree	Disagree
1.The application is easy to use	69 (97.2%)	2 (2.8%)	0 (0%)
2.The application has a friendly User Interface	70 (98.6%)	1 (1.4%)	0 (0%)
3.The application provides Clear points and Ranking System	67 (94.4%)	3 (4.2%)	1 (1.4%)
4.The application provides a good feedback system	66 (93.0%)	2 (2.8%)	3 (4.2%)
5. The Learning procedure is easy to understand	64 (90.1%)	7 (9.9 %)	0 (0%)
6.The application has efficient difficulty level settings	60 (84.5%)	5 (7.0%)	6 (8.5%)
7.I love the Time trial challenge provided by this application	59 (83.1%)	10 (14.1%)	2 (2.8%)
8.I love the Rewards and Badges given by this application	68 (95.8%)	3 (4.2%)	0 (0%)
9.The application has clear learning Instructions	66 (93.0%)	4 (5.6%)	1 (1.4%)
10.The application motivates me to learn English vocabulary the more	67 (94.4%)	3 (4.2%)	1 (1.4%)
11.I enjoyed playing with this application	64 (90.1%)	7 (9.9%)	0 (0%)

Table 1. Summary of users' responses to online survey

According to these results, many participants indicated "Agree" for most of the contents, however the results are presented for the 11 contents.

Content 1: Ease of use, has the second highest number of "Agree" responses (97.2%), 2.8% number of "Neither Agree nor Disagree" responses and no "Disagree" response. This shows that the users really find the application easy to use.

Content 2: User friendly interface, received the highest number of "Agree" responses (98.6%), the lowest number of "Neither Agree nor Disagree" responses (1.4%) and no "Disagree" response too. This shows that users find the Interface very attractive and interactive.

Content 3: Clear points and ranking system, also received a high number of "Agree" responses, with 94.4% of the users agreeing, 4.2% "Neither Agree nor Disagree" and only 1.4% of the users disagree. Therefore, it is believed that the system provides clear points and good ranking system.

Content 4: Good feedback system, received 93.0% "Agree" responses, 2.8% "Neither Agree nor Disagree responses" and 4.2% "Disagree" responses. Thus, it can be concluded that the users are satisfied with the quality feedback the application provides.

Content 5: Which is aimed at knowing if the learning procedure is easy to understand also received high "Agree" responses (90.1%) and no "Disagree" responses. This shows that the participants found the learning procedure easy to understand.

Content 6: Efficient Difficulty level Settings received the highest "Disagree" responses, although, it also received a high number of "Agree" responses. This might be due to the fact that users were required to answer all questions in a particular level correctly before they can move up to a new level and as such, some users felt it was too difficult to move up the game levels.

Content 7: Time trial challenge, received the lowest number of "Agree" responses and the highest number of "Neither Agree nor Disagree" responses in the survey. It is considered that the time the users were provided to complete a task or challenge was too little and thus, some were unable to complete a particular level.

Content 8, Good Rewards and badges, received the third highest number of "Agree" response and no "Disagree" response, which showed that users really loved the rewards and badges given by the application.

Content 9: Clear learning instructions, received 93.0% "Agree" responses, 5.6% "Neither Agree nor Disagree" responses and 1.4% "Disagree" responses. Therefore, it is believed that learners understood clearly the learning instructions given by the application.

Content 10: "Motivation" also received a high number of "Agree" responses and few "Disagree" responses. as such, they were motivated by the application to keep learning English vocabulary the more.

Content 11: "Enjoyment" also received a high number of "Agree" responses and no "Disagree" responses. This showed that users enjoyed playing with the application.

This system, when compared with other existing e-learning systems in the literature using some performance metrics showed a high performance as against other related works. The comparative results are shown in table 2 below. The motivation level of the developed application is considered to be high, due to the fact that more gamification elements and word pronunciation functionality were used as against others. The developed application employed more elements than others, such as the use of leaderboard to motivate users the more and question review functionality. The developed application can also run on the latest Android operating system which the others lack.
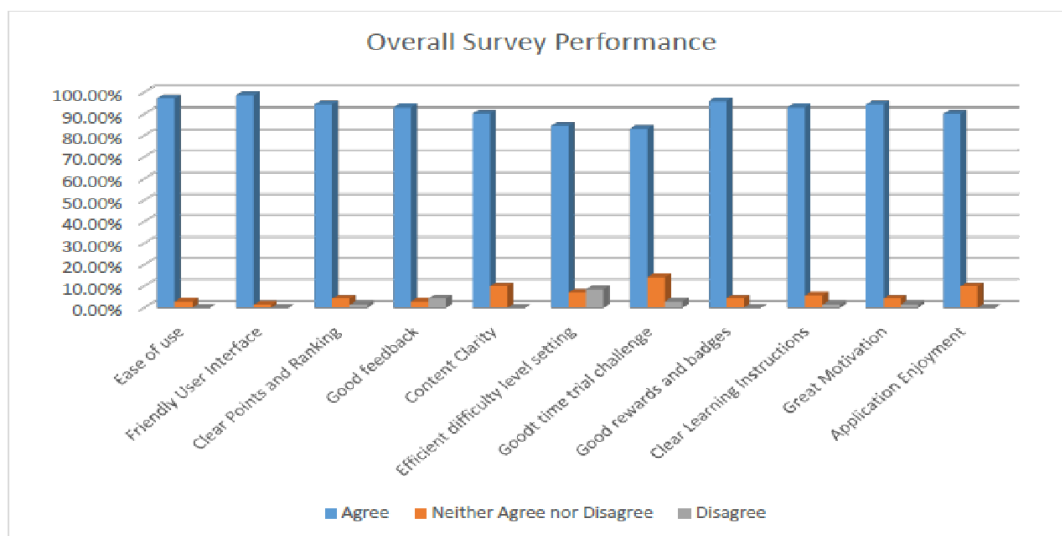

Fig. 15. Graph showing the survey performance

Table 2. Comparison of current work with existing related works

Performance metrics	Hasegawa et al.,2015	Lam S.L, 2014	Current Research
Motivation level (from users responses)	High	Average	High
Game elements used	Points, Badges, Level, Avatars, Progress bar, Reward System, feedback system	Points, Level, Avatars, Reward System, feedback system	Points, Badges, Level, Avatars, Progress bar, Reward System, Leaderboard, feedback system
Word Pronunciation functionality	Used	Not used	Used
Question Review	Not used	Not used	Used
Supported Android Platform	2.2 to 4.0	None	4.4 and above

VII. Conclusion

Gamification might be a new concept, but it has been successfully used in the business and education world. Gamification not only uses game elements and game design techniques, but it also empowers and engages learners with motivational skills towards a learning approach and sustaining a relaxed atmosphere. Gamification has also been found to fortify the teaching and learning experience in the 21st century, as it helps learners to be motivated towards learning because of the positive and immediate feedback they get from the game.

In this system, a mobile English vocabulary learning system that incorporates gamification techniques as a source of motivation to learners was developed. This application is equipped with necessary game functions for English vocabulary learning. In addition, information technology, such as gamifying techniques, text-to-speech functionality, and effective difficulty level settings using the difficulty curve model were utilized.

Experimental results revealed that the developed system can significantly enhances learner English vocabulary abilities and promotes learning interests. The online survey showed 97.2% response for ease of use, 98.6% for friendly user interface, 93.0% for good feedback system and lastly 94.4% response for learner's motivation. More significantly, the system facilitates a seamless ubiquitous learning environment for English learning without constraints of time or place using mobile devices. Therefore, an application that supports self-learning and increased learners' motivation has been implemented.

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