The Development of a Collaborated Gamified E-Quiz and Strategy Game Mobile Application to Increase Students' Motivation and Continuance Usage Intention

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Abstract: Gamification has been taken seriously as an educational approach that is able to facilitate learning, encourage motivation and engagement, improve learner participation and lesson interactivity, and stimulate learners towards the expansion of their knowledge. Given the changes in the digital world over the last decades, students of the current generation expect technology to be used in advancing their learning, requiring a need to change traditional passive learning methodologies to an active multisensory experimental learning methodology. This study introduced, 'Kingdom Quizzes' (KQ) a gamified e-quiz mobile application which was previously known as 'Quiz Seeker' mobile application as an assisting tool in teaching and learning. The purpose of the development of KQ is to enhance the students' motivation in academic task as well as retaining the users of a gamified e-quiz. KQ is divided into two interconnected modules; (i) quiz module, and (ii) game module. This product focused on the 'reward' element resulted from ranking in the quiz session in which it will be passed on to the next game session. The marks and rank that the students gained in the quiz session will reward them with coins or 'life' item in their game inventory. This creates a sense of 'motivation' in students to do well in their quiz sessions as well as creating a 'continuance intention' in using the product which means high tendency to keep executing e-quiz for various other subjects. Based on the survey conducted with 141 respondents, KQ basically managed to fulfill the objectives of the product development which were to increase the students' (i) motivation as much as 93.7% and (ii) continuance intention in using the gamified e-quiz application as much as 88.72%. Based on the Pearson's correlation analysis, motivation has a significantly moderate relationship with continuance usage intention, ($r = 0.607**$, $p = 0.000$). Moreover, the multiple regression analysis using the enter method also proved that predictor motivation contributed 36.9% towards the continuance intention of the students to use KQ. The product does not only manage to be adopted among the targeted audiences, but based on this study it has a huge future potential as the choice for mobile-based quick formative assessment.

Keywords: Gamified e-quiz, tower defense game, learning tool, android mobile application

1. Introduction

As Pivec & Pivec (2011) points out that although video games have been around for nearly 40 years, and games-based learning (GBL) has been researched for over 20 years, the uptake of this technology in the classroom has been slow. As yet there are no definitive studies on the effectiveness of games, nor how they can be used for formal assessment purposes, or for learning in the home. According to Jamaludin (2000), different approach in teaching and learning are able to provide opportunities for students to apply what they have gained in the course of everyday life. According to Mishra & Sharma (2005), the application of technology in education brings benefits to the global economy. Multimedia-based learning approach to transferring information from a form of static text books to a new learning patterns are more interesting (Jamaludin, 2000). One of the applications of gamification in education is training working memory (Farcas, Szamosközi & Takacs, 2016) within online educational courses (MOOC) (Chang & Wei, 2016), in order to engage students in educational environments (Landers & Landers, 2014). On the other hand, Sanchez, Langer & Kaur (2020) study aimed at enhancing the understanding of which gamification can improve learning outcomes (e.g., Koivisto & Hamari, 2014; Landers, Bauer & Callan, 2017; Sharifi Fard, Alkelani & Tamam, 2019) by building on the theory of

gamified learning (Landers, 2014) and the well-established educational benefits of the 'testing effect'. 'Testing effect' refers to Baird (1985) and Rowland (2014) studies proving that testing can enhance learning through the cognitive process of recalling information. In Sanchez et al. (2020) research, they applied gamification on an online quiz (e-quiz) module that was already embedded in an online learning management system (LMS) which discovered that, students engage in more preparational quizzes when game elements are added, and also the research provided the instructors with insights on the potential effects of gamification within the setting of online quizzes. Meanwhile, gaming which commonly known as giving enjoyment to the users especially youngsters, is associated with the term hedonic motivation. Hedonic motivation is defined as the fun or pleasure derived from using a technology, and it has been shown to play an important role in determining technology acceptance and use (Brown & Venkatesh, 2005). In IS research, such hedonic motivation also conceptualized as perceived enjoyment has been found to influence technology acceptance and use directly (e.g., van der Heijden, 2004; Thong, Hong & Tam., 2006, Venkatesh, Thong & Xu., 2012).

The purpose of this study is to introduced the new gamified e-quiz mobile application named Kingdom Quizzes (KQ) that was recently developed as a refinement of its predecessor which was called Quiz Seeker (Figure 1) developed in the year 2018. Apart from discussing the background of KQ, feedbacks from the usage of the product will also be discussed which involved verification of usability, users' continuance usage intention as well as effect in the motivation (Rianto, Kuat & Tentama, 2020). KQ was initially aim to increase the students' engagement in the classroom when the e-quiz is being conducted as well as increasing the teachers' awareness regarding each students' ability in the particular subject. KQ addresses these following issues; (i) current module-based learning which only incorporates texts and diagrams does not really capture the students' interests in doing exercises, and (ii) students lack focus thus resulted to poor engagement in class. The purpose of KQ development is to produce a medium for the educators to execute test base assignment or 'drill and practice' activity so as to equipped the students with the knowledge of questions structure and also to increase their comprehension in an interesting and engaging way (Göksün & Gürsoy, 2019; Lopez & Tucker, 2019). KQ presents sets of 'customizable' questions in the form of e- quiz (maximum 40 questions each set) which also offers an adventure game playing afterwards. The relation between these 2 modules is the reward received in the quiz session can be utilized in the next session which is in the tower defense game session. This is to create a fun learning environment that is less stressful in order to help raise the level of student understanding and participation. The objectives of KQ are listed as follows; (i) to design a gamified e-quiz with the combination of a strategy game that could stimulates students' motivation and continuing interests and (ii) to develop a 'customizable' e-quiz mobile application that incorporates game to retain the students' motivation and continuance usage intention.

Fig. 1. Predecessor product (Version 1).

1.1   Background

The background studies have been conducted towards two types of multimedia-based learning sources which are (i) module-based learning application such as courseware, videos and quizzes and (ii) game-based learning application. Most course wares that have been studied are those produced by previous Diploma students in UTHM for their final year project such as courseware for course Data Structure (Afiqah, Fatin & Fatin, 2014) and Java Programming (Rasyiqah, Nursyafiqah & Nuridah, 2014) and in which all are produced in 2014. Videos and quizzes from various sources over the internet have also been explored. Meanwhile, studies on game-based learning application were conducted on Educational Game for Introduction to IT course (Mohd, 2014) and Captain Carnival game by Azlan & Kumar (2016) developed by diploma students from UTHM. The Captain Carnival game is a first-person shooter (FPS) concept game playing applied on a desktop-based game (.exe) in which the users are acquired to shoot the correct answer for the quiz displayed by shooting the moving object (mouse click action). The questions of the quizzes are based on the literature novel called 'Captain Nobody' for Form 4 Secondary School students in Johor. The development of Captain Carnival game involved Flash CS6 with action script 2.0. The downside of this game is that it can only be played solely on windows-based desktop and by using mouse and keyboard (bonus round which is car game). This means that it is not available as an android or mobile application which is more relevant to the current technology and trend (Pratama et al., 2021). On the other hand, the content (questions of the quiz) is also static', meaning that it cannot be change or updated from time to time which will resulted to the game being obsolete in the future. Feedback gathered

from them showed that these are the factors of the product failed to retain the current users and also may fail to entice new user especially those from higher institutions; (i) poor graphic, (ii) repetitive style of game action (running and jumping), (iii) lack challenges in game mechanics, (v) no motivation in terms of competing with peers, leaderboard, reward that is useful, (iv) does not store previously done questions and answers for revision purpose and (vi) player tends to lose the 'momentum' of playing the game and focusing on the question topics due to alternate switching task from game to quiz. This 'alternate' method of Quiz Seeker, creates interruption in enjoying whether the part of answering quiz or playing the game itself. From the educators' feedbacks, Quiz Seeker posed difficulties in the process of updating the questions in the game. This is due to the educator module was not fully developed in the product. The method of updating the questions was through a third-party software in order to update the' json' file containing the questions. Moreover, Quiz Seeker is not an online application, which made the process of updating questions in quiz module a hassle. Only 1 quiz (a set of questions) may be implemented in one mobile device.

1.2 Scope

KQ target users are still the same with the previous product (Quiz Seeker) which are the student and educator. The motivation for the development of Quiz Seeker and KQ is to increase students' engagement and interest in learning and doing assessment, which means that this products' focus is on the needs of students. KQ incorporates 'reward' concept that is interconnected with the game module in this product, in which differs from Quiz Seeker. The reward obtained from the quiz module will be accumulated in the 'inventory' of the player which later can be utilized to increase items such as weapon, coin and live to defend the 'kingdom' in the game module. KQ can be downloaded anywhere on android platform as same as Quiz Seeker, but KQ has to be operated with internet connection as it keeps the student and educator login information and progress. KQ can be downloaded for free from the Google Play Store but this product has an 'in-app purchase' where it is embedded in 'Create Course' function. KQ can save history of quiz created and already answered, meaning that the students will be able to do their revision by studying previous questions and answers in each course. The number of questions that can be inserted into 1 set of quiz is 40 questions at most. KQ can be used from primary schools to higher institute environments. KQ is produced as an 'android mobile application' which means creating questions by educator as well answering the quiz by students can be done by using their mobile devices.

2. Research Method

KQ adopts ADDIE model for the development methodology, same as its predecessor, Quiz Seeker. With the reference from its first version (Quiz Seeker), plenty of adjustment and refinement had been done for this new product. Each phase in ADDIE has its own purpose, which lets developers set the pace of work while carrying out the construction process. ADDIE stands for Analysis, Design, Development, Implementation and Evaluation.

2.1 Analysis Phase

In this phase, the process of analyzing requirements based on the newly structured product which is an enhancement of Quiz Seeker was being done. For example, an analysis of types of game preferred by students was carried out. Based on observation, current trends, as well as verbal feedback from students themselves, a 'strategy game concept' is much more preferable by not only teenagers but also children in primary school. The software/product requirement for version 1 (Quiz Seeker) and this new version, KQ was also gathered from a public primary school, SK Kampong Raja, Pagoh, Johor apart from the Diploma of IT, UTHM. The maximum number of questions that can be inserted by educator in each set of question is also based on the number of questions for UPSR (Malaysian examination for standard 6 primary school) Mathematics paper. In addition, some other analyses such as the analysis of potential users and the analysis of the learning environment were also carried out.

2.2 Design Phase

The whole view regarding the theme of the product, structure, gamification elements, types of game and technology were confirmed after the analysis phase. The flow or design of the product was revised, in which the theme of 'Medieval Age' and 'Kingdom' concept was chosen. The product was restructured on the basis of eliminating 'interruption' that was in the previous product (Quiz Seeker). The 'interruption' meant here, resides in the part where the player or student is expected to give the correct answer to the question which 'popped up' upon colliding with the object chased by the character in the game. KQ improved this deficiency by dividing the activities into two parts; (i) answering part (quiz section) and (ii) game playing part (game section). Although it is being divided into 2 parts, both modules or sections are correlated with each other through 'reward' element. The reward from quiz section will contribute to the 'inventory' of item that can be utilized by the players in their game section. The quiz reward is defined by 'ranking' achieved by the player. Depending on the ranking, player will receive item such as 'Live' or 'Coin' that they may choose to use in their tower defense game. The detail of quiz reward is listed in Table 1.

Table 1: List of reward that correspond to the ranking achieved in quiz session.

Reward	Ranking	Reward	Ranking
20 coins	1 - 5	10 coins	6 – 15
Life	16 - 30	5 Coins	>= 30

2.3   Development Phase

In the development phase, the application was developed using game development software which is the Unity 3D. It uses C# programming language as well as incorporating Firebase Realtime Database that stores and sync data 'real time' to store the questions and answers for the quiz section. For start, KQ used the Spark Plan which is free but later will be able to enhance the database according to usages which is the Blaze Plan (payable). The architecture of KQ is being displayed in Figure 2. It involves authentication of users, which are the educator and student. The game section was firstly developed, followed by the database, login and quiz section. Lastly, the connection between quiz section to the game section was constructed in which involves 'reward' concept resulting from answering quiz that contributed to the inventory of the gameplay.

2.4   Implementation Phase

The implementation phase is aim to make sure that this application is built to meet the objective and is suitable for the usage of the targeted users. This way, problems can be identified which were not realized during the design phase and during development. This phase has produced a complete functional application for the educator module and student module as shown in Figure 3 and Figure 4 respectively. The educator module presents educator with e-quiz function that has to be purchased with the price of RM4.49 ($1.49) per course. Any students can choose to perform the quiz provided that they insert or choose the course id. The record of quiz that was answered will be kept in the database for future revision by students. The ranking and result that the student gained after each quiz session will contribute to the game session through inventory system. Player may choose which weapon in their inventory system that they wish to use in the game session. This means that the better rank that the student gets in the quiz session, the higher chance of winning the tower defense game that they will experience. This is due to the accumulated weapons and item that they had gained for selection in their inventory system. There are 3 levels in the game which adopts 'Medieval Age' theme where the player has to defend the 'Kingdom' from enemies (trolls, giants, wild animals, flying enemies) by selecting the type of defender object (archer, cannon, wizard) in each tower station. The objective is to prevent the enemies from passing through the last fort (tower).
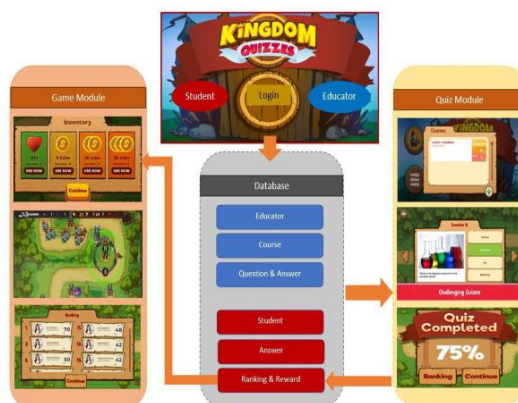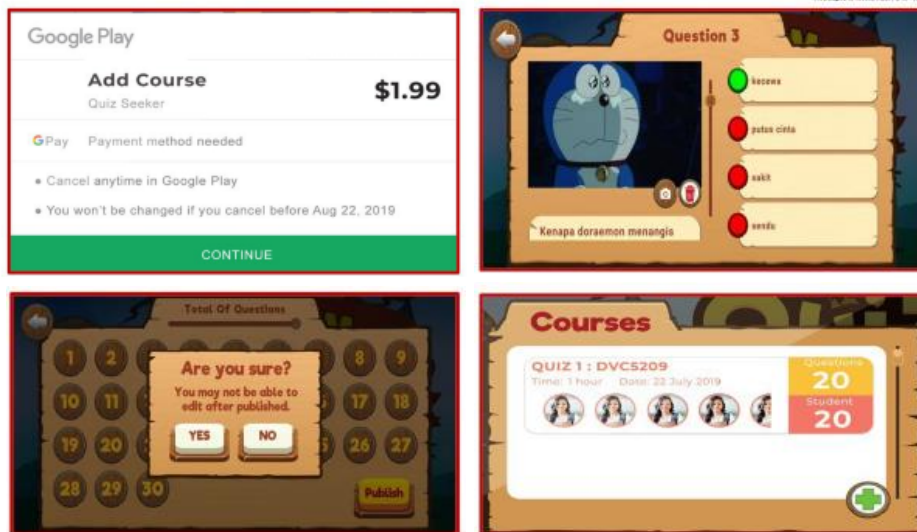

Fig. 2. The architecture of KQ.

Fig. 3. Interfaces of Educators' account in KQ.

Fig. 4. Interfaces of Students' account in KQ.

2.5   Evaluation Phase

In this evaluation phase, the study made (i) comparison between the functions and features of other gamified e-quiz applications such as Quiz Seeker and Kingdom Quizzes (KQ) in Table 2 and (ii) conducting integration testing and module testing towards KQ as it involved network connection, cloud database as well as purchasing module (in Google Play Store). This is to ensure that the product developed fulfils the objectives and free from defects or bugs.

Table 2: Comparison of a few elements between Quiz Seeker and Kingdom Quizzes.

Element	Quiz Seeker	Kingdom Quizzes
Educator Module	X	√
Progressive Game	X	√
Leaderboard/ Ranking	X	√
Cloud Storage	X	√
Authentication/Login Function	X	√
Revision Function (students' answers stored)	X	√
Internet Connection	X	√

3. Results and Discussion

The success of this study focused solely on the development of a gamified e-quiz mobile application that had the elements of enhancing the students' motivation and interest in continuing using the product. Therefore, three quizzes have been executed in the duration of five weeks during the first semester of students Diploma of IT, UTHM cohort 20202021. Based on five weeks usage, the users are assumed to have had ample time to get to know KQ before filling in a survey that was given on the sixth week. The survey handed out, contained questions with five-point Likert scale (1. Strongly Disagree, 2. Disagree, 3. Somewhat Agree, 4. Agree, 5. Strongly Agree) to verify both objectives of the study (motivation and continuance intention) as well as other questions that highlighted the positive effect that KQ might have had towards the students for the past five weeks of usage.

3.1 Population and Sample of the Study

The population of this study is the first-year students of UTHM Diploma of IT programme that already had an account in KQ. On the other hand, the sample was taken from participants with the background of an active user. Active user is defined as students that had completed all the quizzes published for them in the KQ application for that semester. Hence, out of the 146 population, only 141 respondents were identified as eligible and accepted for analysis of this study.

3.2 Finding

In this study, the success of the development of a gamified e-quiz mobile application that combine quiz module and game module through a ranking and rewards system (leaderboard) in the quest to increase the students' motivation, hence their continuance usage intention was illustrated in the percentage of agreement among the students. Meanwhile, the relationship between motivation and continuance intention is illustrated using Pearson's correlation analysis (Table 4). Lastly, this study identified the level of contribution that the predictor (motivation) has towards the dependent variable, which is the continuance usage intention using the statistical analysis of multiple regression (enter method).

3.2.1 Response on the usage of Kingdom Quizzes (KQ)

Feedbacks were gathered through Google Form surveys in which resulted to more than 88.72% respondents expressed interest in further usage (continuance usage intention) of KQ with other subjects. Meanwhile, 93.7% stated that using KQ increase their motivation to perform better in the next KQ quizzes. These results corresponded to the success of the development of this gamified e-quiz mobile application in contributing to the users' motivation and continuance usage intention of the product. Other positive effects are as follows; the students tend to (i) improve themselves by doing revision on previous executed quizzes, (ii) prepare themselves beforehand by studying the topics involve in the quiz that they will be doing, and lastly (iii) perform self and peer assessment based on the leaderboard function provided in KQ. Detail of responses are listed in Table 3.

Table 3: Responses regarding the usage of KQ from Google Form surveys.

Question	Percentage % (141 responses)
Continuance intention in KQ usage	88.72
Useful 'leaderboard' display	91.5
Preparation for quiz before KQ usage	93.7
Increase students' motivation	93.7
Useful 'revision' function for self-improvement	98.6

3.2.2 Relationship between motivation and continuance intention to use Kingdom Quizzes (KQ)

Pearson's correlation was performed to investigate the significant of relationship between the students' motivation and the continuance intention to use KQ. Result in Table 4 showed the significant positive relationship between motivation and continuance intention (CI) ($r = 0.607**$, $p = 0.000$). According to rule of thumb Guilford & Fruchter (1973), this relationship was identified as moderate relationship. The result implies that students with high motivation tend to obtain a positive continuance intention in using KQ.

Table 4: Pearson's correlation for motivation and continuance intention (CI) in using Kingdom Quizzes (KQ).

	Continuance Intention (CI)	Strength
Motivation	0.067**	Moderate Relationship

**. Correlation is significant at the 0.01 level (2-tailed)

3.2.3 Motivation as predictor towards continuance intention to use Kingdom Quizzes (KQ)

The result of multiple regression analysis verifies that motivation significantly predicted students' continuance usage intention, (β = .744, t = 9.009, $p < .05$). Regression result indicated that the motivation predictor explained 36.9% of the variance with F $(1,140) = 81.169$, $p=.000 < .05$.

3.3   Summary of the Finding

Based on the result presented earlier, KQ managed to serves its purpose by receiving high frequency of students' responses on their agreement of KQ continuing future usage. Embedding game elements into educational application contributed to the enhancement of students' motivation in learning and usage of the product, which eventually means retaining the students' interest in the specific product. This also signified motivation as one of the predictors (36.9% influence level) to students' continuance intention to use KQ.

4.   Conclusion

The aim of this study which is to increase the students' motivation and continuance intention in using a gamified e-quiz application motivated the development of a mobile application named Kingdom Quizzes (KQ). Positive responses gathered witnessed the users verifying the usefulness of the gamification functions embedded in this product has increase the motivation amongst the students (users), hence keeping them interested in the future usage of the product. The application can help the students perform e-quiz and revision in an interesting way, ease the educators' work and also enhance the quality of teaching and learning. Students are known to be competitive especially when playing, thus this product hope is to instilled the enthusiasm amongst the students to perform e-quiz while having fun. KQ represents itself (i) as a 'portable' medium of learning in the form of a 'quiz' adventure game using mobile devices, (ii) as an enhancer for the engagement in teaching and learning inside and outside of the classroom, and (iii) as a transformation from paper-based quiz into electronic quiz (e-quiz) on android platform. Furthermore, this product will not be obsolete as the quiz is 'dynamic' and can be newly created at any time according to their preferences,

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