

A User Acceptance Testing Tool for Mobile Game-based Learning Application

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Abstract: This study developed a user acceptance testing tool designed to guide the creation of mobile game-based learning applications. Topics involving mobile game-based learning applications, mobile learning, game-based learning, user acceptance test tool, and technology acceptance model were analyzed to come up with the different assessment constructs for evaluating a mobile game-based learning application. After identifying these constructs, the researcher had the constructs validated by selected panels of experts from the academe and industries to see if it is relevant in assessing a mobile game-based learning application.

Overall, results revealed that the User Acceptability Test tool for Mobile Game-Based Learning application constructs and measurement items were assessed to be very highly relevant in terms of Learning Content, Game Experience, Personalization, Learning, Experience, Learning Objective, and Game Design. Hence, the findings indicate that the developed user acceptability test tool can be utilized to evaluate a mobile game-based learning application.

This study could be expanded to include people from different countries and cultures, which would make the instrument more encompassing.

Keywords: Game-based learning, mobile learning, user accessibility test tool, technology acceptance model

1. Introduction

Higher education's teaching and learning techniques have steadily evolved, particularly with incorporating information and communication technologies into the curriculum and learning environment. The increasing demand for mobile game-based learning applications as supplementary educational tools necessitates that developers meet user expectations. In addition, students' adoption of mobile learning is seen as an essential step in ensuring that mobile learning is implemented successfully. Also, it has been claimed that the lack of adoption of mobile learning is due to technological concerns rather than the quality of teaching (Fedirko, 2020). Bidin and Ziden (2013) also pointed out that just a few studies have focused on the technological components of mobile game-based learning applications and how they impact their acceptance.

Today, researchers are developing game-based learning on mobile devices as an alternative learning media to give students engaging learning that is accessible and easy to understand. Mobile Game-Based Learning has recently emerged as a new educational trend, given the fact that most mobile devices, particularly smartphones and tablets, are capable of running user-friendly mobile applications. This educational trend can improve student performance since it is more appealing to use as a learning tool. As a result, mobile game-based learning can drive learners to learn more passionately while also aiding the user's engagement with the application itself.

Chin and Lee (2017) emphasize that game interface design is crucial in attracting student interest and enhancing engagement in educational games. A simple design and clear instructions can facilitate learning. Thus, interface design should be a key consideration in developing mobile game-based learning applications, as it presents both advantages and disadvantages. The User Acceptance Test (UAT) is vital for ensuring that new systems meet specifications. Jawad and Hassan (2015) note that the UTAUT model is widely used among Information Systems researchers, showing favorable behavioral intentions toward mobile learning. However, a UAT specifically for mobile game-based learning applications has yet to be developed (Gao, 2011). This study aims to create a user acceptability tool to evaluate Mobile Game-based Learning (MGbL) applications.

2. Objectives

This study focuses on the development of a user acceptability test tool for mobile game-based learning applications,

Specifically, it aimed to:

1. identify the existing requirements, technical aspects, and factors that affect the user acceptability of a mobile game-based learning application;
2. design and develop a tool for evaluating the user acceptability of a mobile game-based learning application; and
3. validate the developed user acceptability test tool.

3. Conceptual Framework

Figure 1 illustrates the conceptual framework of the study using the input-process-output model. The input of the study includes a) data on relevant studies on the requirements of a Mobile Game-Based Learning application; and b) existing User Acceptance Tool for Mobile applications in general and specifically for Mobile Game-Based Learning applications. The result was the basis for designing and developing the tool for user acceptability of a mobile game-based learning platform that will gauge student and teacher interest in using a mobile application. The process presents the major steps that were undertaken by the researcher in the designing and developing of the user acceptability tool for a game-based mobile learning application based on questionnaires and surveys. As a result, the research was a user acceptability tool specifically for a Mobile Game-based learning platform.

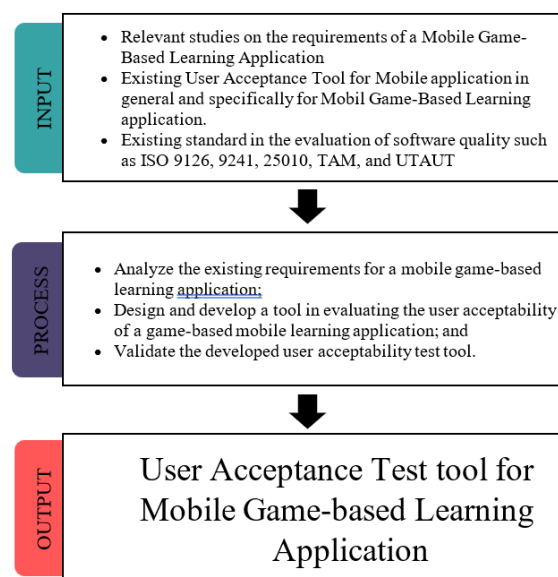


Figure 1. Conceptual Framework.

4. Methodology

4.1 Analyze Existing Requirements for MGBL

A systematic mapping technique based on principles from Petersen (2008) and Petersen, K.V. (2015) was utilized to identify existing requirements. The systematic mapping procedure encompassed three stages: Planning, Conducting, and Reporting.

The literature search utilized the keywords “mobile-based application”, “mobile learning”, “game-based learning”, “user acceptance test tool”, and “technology acceptance model” to identify relevant studies within the Google Scholar and Open Knowledge Maps databases. The selected articles were evaluated based on the following inclusion criteria: (1) written in English Language, (2) publication within the last 15 years (2006-2021), (3) specified the criteria used to assess the mobile app and (4) at least one citation. Articles were excluded from the analysis if they met any of the following criteria: (1) were not written entirely in English, (2) had zero citation or (3) not providing specific evaluation criteria for the mobile app. To facilitate comprehensive analysis, key data points were extracted into a spreadsheet, including authors, title, year of publication, number of citations, and criteria in evaluating the developed mobile app.

The analysis conducted to determine the preliminary constructs for the User Acceptability Test (UAT) tool for mobile game-based learning applications involved a systematic mapping process based on 92 selected studies. Initially, the researchers identified data sources and executed search strings related to mobile game-based learning to select relevant articles. Inclusion criteria mandated studies to be published in the last 15 years and cited at least once, while non-English articles and those lacking evaluation criteria were excluded. Ultimately, 75 distinct constructs were extracted from these studies, which were then refined by merging similar constructs to enhance reliability.

To establish the reliability of the UAT tool, the researchers validated the identified constructs through a panel of experts. This validation involved using a questionnaire rated on a five-point Likert scale, assessing the relevance of each construct. Constructs achieving a mean rating between 3.41 and 5.00 were considered “very highly relevant,” indicating strong consistency in the tool's design. The final constructs included Learning Content, Game Experience, Personalization, Learning Experience, Learning Objective, and Game Design.

4.2 Design and Development of a User Acceptability Test Tool

To determine the constructs of a UAT tool for mobile game-based learning applications, the research conducted extensive research on the concepts of mobile game-based learning applications and user acceptability.

4.3 Validation of the UAT

The validity of the UAT tool was confirmed through expert feedback and statistical measures, utilizing mean ratings to assess each construct's relevance. Composite mean scores ranged from 4.54 to 4.84 for all six constructs, indicating that the tool effectively measures user acceptability in mobile game-based learning applications. A survey questionnaire was distributed to targeted respondents for validation, evaluating six constructs: Learning Content, Game Experience, Personalization, Learning Experience, Learning Objective, and Game Design. A five-point Likert scale was employed, ranging from 1 (“Not relevant”) to 5 (“Very Highly Relevant”).

5. Results and Discussions

5.1 Existing Requirements and Technical Aspects that Affect the User Acceptability of a Mobile Game-based Learning Application

A comprehensive literature search yielded 220 relevant studies. After applying stringent inclusion and exclusion criteria, 92 studies were retained for in-depth analysis. These selected studies were systematically reviewed to identify and categorize evaluation constructs used in assessing mobile game-based learning (MGBL) applications. A total of 75 distinct constructs were extracted. To enhance construct reliability, similar constructs were merged, resulting in a refined set of evaluation criteria.

5.2 Design and Develop a Tool for Evaluating the User Acceptability of a Mobile Game-based Learning Application

In developing the user acceptability test tool, topics involving mobile game-based learning applications, mobile learning, game-based learning, user acceptance test tool, and technology acceptance model were analyzed. It was found that numerous methods for evaluating the quality of software and the user's attitude and desire to accept new technology have been developed. These models include the Technology Acceptance Model, Unified Theory of Acceptance and Use of Technology, ISO 9241, and ISO 25010.

5.2.1 Existing Models and Software Quality Standards

During the data collection process, 75 constructs were found. The constructs were mapped according to whether they are included in existing software quality standards and acceptance models as shown in Figure 2. After mapping, 37 of the identified constructs were classified as related to existing software quality standards and acceptance models. In addition, these constructs weren't included in the proposed UAT tool anymore since they are already part of the existing software quality standards and acceptance model which have been tested and validated.

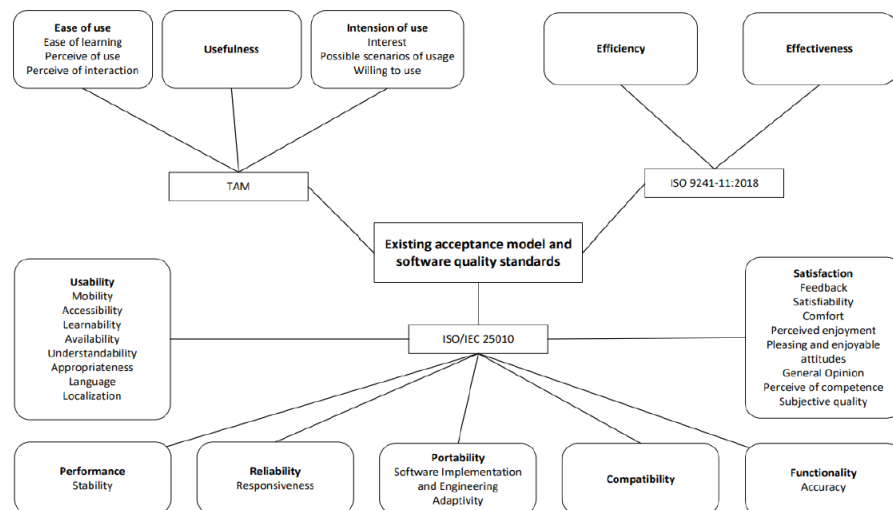


Figure 2. Mapping Process of Existing User Acceptability Model and Software Quality Standards.

5.2.2 Mobile Game-based Learning User Acceptability Test Tool

To come up with the initial constructs of the proposed user acceptability test tool, items that were not categorized were used as constructs in the development of a UAT tool. These constructs were analyzed and clustered based on their description. Moreover, Figure 3 shows the mapping of the proposed User Acceptability Test tool for Mobile Game-based learning applications.

As a result, six constructs were identified, namely: Learning Content, Game Experience, Personalization, Learning Experience, Learning Objective, and Game Design. The researcher was able to determine 10 measurement items from prior research to measure the learning content, 14 measurement items to measure game experience, 7 measurement items to measure personalization, 5 measurement items to measure learning experience, 5 measurement items to measure learning objectives, and 10 measurement items to measure game design. In addition, changes in wording were done to be more generally applicable, some minor word changes were made to elaborate and interpret the statement in the measurement items so that they fit in the mobile game-based learning application user acceptability test tool. Table 2 summarizes the definition of the variables in the user acceptability test tool.

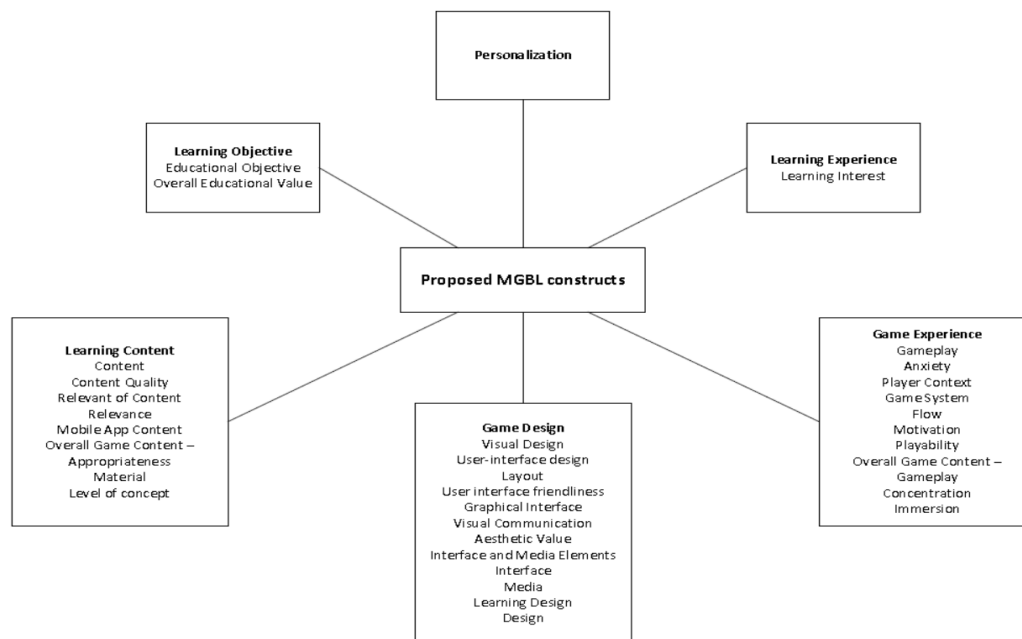


Figure 3. Mapping of the Proposed User Acceptability Test Tool for Mobile Game-based Learning Application.

Table 2. Definition of each construct in the User Acceptability Test

Construct	Definition
Learning Content	Learning content is any written or digital material sources, such as lectures, courses, assignments, images, and quizzes, that are used to teach and learn (Zaibon, 2015).
Game Experience	Game Experience explains how the game is playable, works smoothly and consistently, has a purpose for the user, and is not boring (Shchiglik , 2016).
Personalization	Personalization refers to the degree of customizing of the system's information, services, and user interface depending on the preferences of the user (Almaiah, 2016).

Learning Experience	Learning Experience refers to the player's perceptions of the educational value of the MGBL application (Wong, 2018).
Learning Objective	Learning Objectives refers to the degree to which the mobile application achieves the important targets needed in a learning and teaching process.
Game Design	Game Design determines if the user interface of the mobile game is created effectively (Almaiah , 2016).

5.2.3 User Acceptability Test Tool Validation

The sample comprised fifteen respondents, including eleven employees from Mariano Marcos State University and four industry professionals. Among them, two validators were full-time mobile game developers. Each respondent had substantial experience in developing mobile game-based learning applications, ranging from 1 to 9 years.

During the validation of the user acceptability test tool, fifteen validators assessed the relevance of constructs related to the proposed User Acceptability Test Tool for Mobile Game-based Learning applications, focusing on learning content, game experience, personalization, learning experience, learning objectives, and game design. Their feedback provided insights for enhancing the tool. Mean ratings were utilized to evaluate construct relevance, employing specific statistical limits and descriptive interpretations. The results indicated that all six constructs received composite mean scores between 4.54 and 4.84, confirming their effectiveness in measuring user acceptability in mobile game-based learning applications.

Table 3. *Descriptive rating.*

Quantitative Rating	Statistical Limit	Descriptive Interpretation
5	4.22-5.00	Very Highly Relevant
4	3.41-4.21	Highly Relevant
3	2.60-3.40	Moderately Relevant
2	1.80-2.59	Slightly Relevant
1	1.00-1.79	Not Relevant

Figure 4 presents the composite mean ratings of six key constructs within the User Acceptance Test Tool: Learning Content, Game Experience, Personalization, Learning Experience, Learning Objective, and Game Design. All six constructs received "Very Highly Relevant" ratings from validators, with composite mean scores ranging from 4.54 to 4.84. These results strongly support the use of these constructs as comprehensive assessment indicators for mobile game-based learning applications.

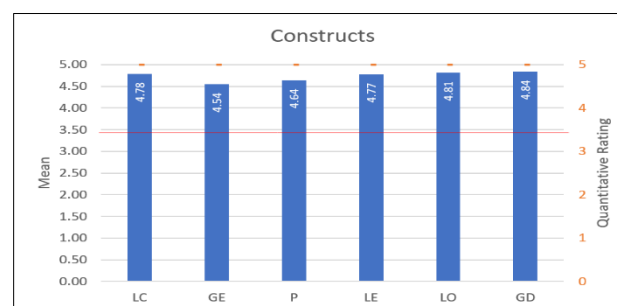


Figure 4. *Validation of Constructs.*

5.3 Mobile Game-based Learning User Acceptability Test Tool

Based on expert feedback, constructs and measurement items achieving a mean rating of 3.41 to 5.00 were incorporated into the Mobile Game-Based Learning (MGBL) User

Acceptance Test (UAT) tool. The tool has been refined based on expert recommendations. The developed UAT tool is ready to be utilized by schools and industries that will be developing mobile game-based learning applications.

6. Conclusion and Recommendations

The development of this user acceptability test tool for mobile game-based learning applications would assist mobile game creators in overcoming barriers to the usage of mobile games for educational purposes. This would also provide future researchers with additional reference material for conducting investigations, especially in assessing and developing a mobile game-based learning application.

The MGBL UAT tool development offered several contributions. The most important contribution was the creation of constructs and measurement items to measure user acceptability, particularly on mobile game-based learning applications. The creation process included identifying existing instruments, mapping of the identified constructs, rephrasing questions as required, and clustering new constructs in the MGBL UAT tool.

In this study, there were six constructs identified namely, 1) learning content, 2) game experience, 3) personalization, 4) learning experience, 5) learning objective, and 6) game design. The relevance of these constructs and their corresponding measurement items were validated by a panel of experts and the results show the composite mean ratings of the 6 constructs for the UAT tool ranging from 4.54 to 4.84 qualify as a very highly relevant. This denotes that the identified evaluation constructs in the UAT tool are appropriate assessment indicators for mobile game-based learning applications with respect to the evaluation of the panel of experts. The findings in this work also provided the foundation for future discussions and instrument development efforts on user acceptability of mobile game-based learning applications.

There are several possibilities for further investigation. In the near future, the researcher plan to test this user acceptability test tool again with a larger group of respondents to increase the confidence rating. This study could be expanded to include people from different countries and cultures, which would make the instrument more encompassing. Also, as suggested by one of the evaluators that it would be useful to add a rubric for each measurement item.

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