# Attitude Towards Intention to Use Mobile-Based Teaching Assessment Based on TAM and a Novel Extended TAM Model

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**Abstract.** In recent years the combination of a rapid development in mobile technology and the pandemic scenario in which currently the world is still in, have caused an increasing demand for online systems that can replace the traditional methods in a variety of areas. For instance, the rising usage of e-learning and e-health are evidence of this reality. Consequently, Mobile Based Teaching Assessment (MBTA) has become the ideal candidate to replace traditional classroom evaluation. The intention of end users to use MBTA as an alternative to traditional evaluation is the main indicator of its adoption in a regular basis. This study has two main goals, the first one is to use the Technology Acceptance Model (TAM) to evaluate how people's feelings towards the usage of MBTA, the second goal is to propose an extended TAM that incorporates intrinsic motivation to the traditionally extrinsic regular TAM. Partially least squares (PLS) were used in this study, and data was gathered from 75 students and academic support personnel using a simple sampling technique, as well as structural model to evaluate the proposed model. Based on the findings of this research, the attitude of individuals directly influences their desire to use MBTA. Along with that, individual's attitude is influenced by a variety of factors, this is more evident in the extended TAM proposed. Despite the indications achieved with TAM regarding the implementation of mobile-based teaching assessment in an academic context, the claimed user attitude explains 75% of the variance in user intention towards MBTA. The importance of the suggested paradigm, as well as the accuracy of the extended TAM proposed, is shown in the results of this work.

**Keywords:** Partial least squares · Technology acceptance model · Mobile assessment in mobile devices


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## 1 Introduction

With global acceptance of technologies for the improvement of learning activities, various portable personal computing, and communication devices (like Smartphone and tablets) made adoption of such technologies a reality. Also, the rapid growth of IT has led to new applications such as e-learning, e- health to replace traditional methods [1]. As a result, mobile-based teaching assessment (MBTA) has developed as a useful supplement to traditional classroom evaluation methods.

Among academics, mobile learning has become a frequent occurrence. Furthermore, it is becoming more widely accepted owing to its accessibility and the fact that it provides users with a variety of capabilities, such as 3G and 4G networks [2]. In accordance with this, O' Malley et al. [3] described m-learning as a kind of learning that allows students to study at any time and from any location while also allowing them to communicate through mobile devices. Mobile technologies support a variety of activities in the educational setting, including dynamic, location-aware, context-aware, collaborative, peer, and self-assessment practices [4]. However, contemporary educational evaluations are not intended to be completed on mobile terminals, but rather on a desktop computer. It demonstrates that students' ease in using the system at any time and from any location receives less attention. As a result, mobile devices should be used in classroom assessment to improve academic services [5].

More specifically, the wide array of a proliferation of technology applications in education environment necessitates a mobile-based teaching assessment. However, learners' recognition of mobile-based teaching assessment has been overlooked, and the effectiveness of the adoption of MBTA raises a question among academics, practitioners, and developers. To that end, special attention is given to the adoption of MBTA. Since the previous literature highlighted the suitability of assessing the computers [6–8]. While other literature stated that mobile learning is encouraged to be adopted in an academic environment [9, 10]. Therefore, from the viewpoint of the Technology-Acceptance-Model, this provides sufficient scope to examine the attitude toward the intention to utilize Mobile-Based Teaching Assessment. In fact, this research will be one of the first to predict the acceptability of Mobile-Based Teaching Assessment.

The paper is structured as follows: the background of Assessments by the mobile technology is presented in section two. Followed by and Technology Acceptance Model (TAM) in section three. Research model and formulation of hypotheses are reported in section four. A methodology is presented in section five. The data analysis is shown in section six. Section seven presents discussions and conclusion.

## 2 Background and Related Work

### 2.1 Assessments on the Basis of Mobile Technology

Technology innovation brought portable devices like tablets, notebooks, and Smartphones allowing academicians gain access to digital content in learning which leads to a new learning mode called mobile learning. In addition, technology innovation offered not only mobile learning but also enabled users to make communication, entertainment, and multiple purpose information processing tools. Therefore, the usage of mobile devices

in higher education improved due to conjunctions with near universal 3G/4G wireless connectivity. In addition to that, mobile learning has features that include ubiquity, portability, low cost, mobility and flexibility engaging users to use the Mobile-learning [11]. On the other hand, mobile devices have a potential effect on improving the outcomes and motivations of the students besides the enhancement of their attitudes since mobile technology has already integrated into learning activities [12]. Consequently, the ubiquitous and mobility features at mobile devices plus the growth of technology enable to perform possible evaluations and create a new technique for the assessments, called Mobile-Based Testing (MBT).

Context-aware adaptation provides support to the educational activities in a mobile learning platform. Economides [13] demonstrates the essential features that affect the quality of using mobile learning devices. Adaptive mobile learning and mobile learner are two ideas in mobile technology, with adaptive mobile learning serving as an engine that personalizes educational activities in a given environment, and the mobile learner doing educational activities. Moreover, mobile devices make a possible extension of services due to their mobility. For instance, mobile learning plays a vital role in various education-related activities, namely performing formative assessment or self-assessment [14]. For that reason, mobile technology can be alternatively adoptable in teaching assessment. Therefore, the mobile devices become inevitable in the adoption of the implications in a real world, and that renders mainly teaching evaluation to benefit them.

### 2.2 Technology Acceptance Model

Due to technology applications proliferation in the academics, a new approach for mobile assessment was innovated to replace the existing traditional methods of evaluation such as paper-and-pencil based or web-based. The mobile devices can access the contents anytime and anywhere. Thus, it is imperative to explore student's acceptance of mobile-based teaching assessment adoption in academic institutions. Various studies were conducted about users' the acceptance to adopt the information system for their lives [15, 16]. For example, a study by Hussein [17] revealed that intention to use the e-learning depends on users' attitude which has a significant part for making the system well performed.

This paper puts forward the technology-acceptance-model (TAM) to explain the relationship between the variables of interest. Perceived ease of use (EoU), perceived usefulness (PU), and attitudes (ATT) are three variables in this theory that characterize and predict system adoption. They have different meanings, since perceived usefulness captures how much a user believes utilizing a specific technology would improve his or her work performance (PU). This factor determines the usefulness and efficacy of mobile teaching assessment in academics. The ease of understandability of such mobile teaching assessment is defined by its ease of use (EoU), which relates to the ease-of-use (EoU) of TAM, since ease-of-use refers to the extent/degree to which a person has strong views that he or she can utilize the system with ease [18]. Finally, the third component of the theory provides light on the users' attitudes that motivate them to utilize mobile-based instructional assessment. In an e-learning system, the attitude relates to the degree to which the user is interested in the MBTA. Furthermore, the voluntary adoption of MBTA in academics is motivated by a behavioral purpose that is affected by attitude. The user's desire to utilize the mobile to manage teaching-related evaluations is predicted

by the general dimensions described above. As a result, the purpose of this study is to look at user acceptability of the MBTA's usage of TAM. It is critical to examine the underlying variables that drive MBTA, which are influenced by the user's behavioral goals and attitude toward technology adoption, either directly or indirectly. Given that TAM is the theory that may be used to verify the interrelationships between the variables in this research. To put it another way, acceptance of mobile learning has previously been used in TAM assessment with a variety of changes and extensions to incorporate a variety of external factors [10, 20]. However, the research on the acceptability of mobile-based instructional evaluation is still lacking. Moreover, the empirical existing literature about mobile based assessment by users shows contradictory results. Mobile users have positive attitude towards MBA according to Chen [21], while other show negative attitude towards MBA [22, 23]. Therefore, this study is first step forward by examining the users' (students and academic support) attitudes which lead to the behavioral intention which results in driving mobile-based teaching assessment.

### 2.3 Research Model and Hypothesis

The reliability of TAM has proven by an extensive number of research. Nonetheless, TAM has an emphasis on the notion of instrumentality, focusing mainly on functional and extrinsic motivations. Such a perception could be limited when dealing with situations out of an organizational environment, where the motivations behind the choices of individuals are not so obvious.

According to research in the field of Psychology and Psychoanalysis, motivations can be classified in two categories, extrinsic and intrinsic motivators. Extrinsic motivation is when an individual is motivated to do an activity to obtain a reward, the focus is on the outcome of the activity. Intrinsic motivation is naturally the opposite, when an individual chooses to do an activity because it is internally rewarding, the activity is satisfactory by itself, therefore the focus is on the activity and not the outcome of it.

Given that psychological principle, it has been proven that intrinsic motivation plays a key role in decision making of individuals, particularly among young people. Taking that into consideration, it becomes clear that TAM, as reliable as it might be in some cases, does not cover the whole spectrum of the motivations behind the decisions of people in this case, mainly because the environment is more varied and the individuals targeted are younger, thus with a higher tendency to base their decisions on intrinsic motivation.

That is the main reason why it was decided to extend the previously presented model, using a regular TAM model, and introduce an extended TAM model including intrinsic motivation. This motivation has been included in the form of two factors: System Quality Perception (SQP) and Enjoyment (E). The relation between these two new factors and the previous model is based on research in the fields of psychology, pedagogy and information systems, as well as data gathered in this research to prove the reliability of the proposed model.

Established on the factors mentioned, the extended model proposed is the following:

The first introduced factor is System Quality Perception (SQP). This involves aspects such as system quality, information quality and content quality, as well as the availability of the system as a whole. Instinctively, the quality of a system influences the Ease of Use

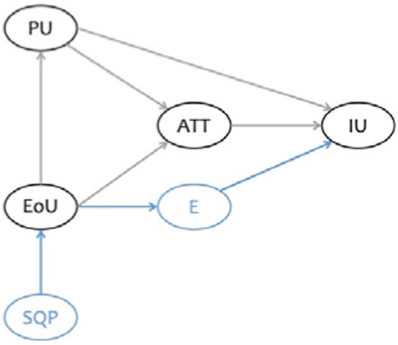


**Fig. 1.** Describes the proposed extended model to be adopted in this research

(EuO), since a good quality system consists of well documented and planned features that will allow users to navigate in the system and use its resources efficiently. With that said, quality can be interpreted in a variety of ways, objective and subjectively.

Given that the focus of this research is the intention of people to use mobile-based teaching assessment, and that the targeted demographic consists of mostly young people who tend to base their decisions on intrinsic motivation, the interpretation given to quality in this model has an additional aspect, which is the perception. Hence, System Quality Perception conveys the objective and subjective features of quality in a system, such as the actual usability and availability of the system, as well as the statics of the system, that influence enormously the perception of the end user regarding to the quality of the system.

The second new factor is Enjoyment (E). This is entirely an intrinsic motivation and as the name suggests it refers to the enjoyment while using the system. It is directly influenced by the Ease of Use of the system, naturally a user-friendly system increases the enjoyment of the end users, that is the reason why social media developers put so much effort in making their systems as intuitive as possible. If the user enjoys using their system, he will come back to use it again.

Continuing with those principles, Enjoyment is indirectly influenced by the System Quality Perception. Given that this factor consists subjective aspects like the appreciation of statics, it is clear that these also influence the overall enjoyment of the user while using the system. Regardless of that, these aspects are not directly influencing the Enjoyment factor due to the fact that subjective aspects like the statics of a system cannot make the end user enjoy using the system if the system is not functional itself. It is the combination of functional and static aspects that influences the enjoyment of the end user. Such a relationship is portrayed in the proposed model.

## 3 Proposed Methodology

### 3.1 Participants

Random sampling technique was conducted to select participants for the survey. A Total of 75 participants were collected from undergraduates, graduates studies, and academic

support of Universiti Putra Malaysia (UPM). In which 50 out of 75 making (66.67%) were students and 25 (33.33%) academic support, while males constituted of 46 (61.33%) and 29 females (38.67%).

### 3.2 Procedure and Instrument

A quantitative approach was conducted in this paper by using a survey. A questionnaire was formulated based on the TAM constructs from previously validated instruments. The English language was designed to build the survey questionnaire. All items were graded on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (strongly agree). Construct three items for Perceived Usefulness (PU) and three items for Perceived Ease of Use from [26]. We utilized six questions from [27] to evaluate Attitudes toward (ATT) and Intention to Use (IU) of Mobile-Based Teaching Assessment, and we upgraded the items slightly to reflect the current research environment (mobile-based teaching assessment). The item "In the future, I plan to utilize e-learning" was changed with "In the future, I want to use mobile devices for teaching evaluation. "In addition to that, to describe and explain the features of the Mobile-Based Teaching Assessment, we have given to the participants 10 min presentation before answering the questionnaire, and 15 min to complete the questionnaires. To validate and analyzing data for the variables that effect the implementation of teaching assessment through mobile technologies. Smart PLS Version 3.0 software was used to test the measurement and structural model of this analysis.

## 4 Data Analysis

We utilized Smart PLS Version 3.0 to offer the study model's convergent and discriminant validity in order to evaluate and verify its quality. As a result, to verify that the concept indicators are genuine, the convergent validity must be assessed. The model's validity must meet the following measurement requirements: (1) constructs with factor loadings higher than 0.700 are acceptable; (2) each variable's composite reliability must exceed 0.700; and (3) each construct's Average Variance Extracted (AVE) must likewise exceed 0.700.

The results in Table 1, indicates that all the measures for convergent validity passed and verified. In the factor loadings, the results of all variables are in between 0.755–0.942 that means they exceed 0.700. Also, the Average Variance Extracted (AVE) values indicate that they are in the range of 0.665 to 0.760 (AVE $>$ 0.5). In addition, the values of root squared of AVE as shown in Table 2 are greater than correlation of corresponding constructs. As a result, all AVE square root values are higher than the construct inter-correlation values. As a result, the suggested research model's convergent and discriminant validity are both confirmed.

We used PLS-Graph to complete the SEM by calculating the R-squared values and Path coefficients. We also tested whether hypotheses formulated are in line with the study expectations or not. Therefore, the results reveal that all hypotheses tested are in accordance with expected signs. These imply that relationships among variables are statistically significant and positive.

**Table 1.** Convergent validity of the model

| Items | Factor loading (>0.7) | Cronbach's (>0.7) | Composite Reliability (>0.7) | Average Variance Extracted (>0.5) |
|---|---|---|---|---|
| **EoU** | | 0.746 | 0.856 | 0.665 |
| EoU 1 | 0.799 | | | |
| EoU 2 | 0.878 | | | |
| EoU 3 | 0.764 | | | |
| **U** | | 0.780 | 0.872 | 0.695 |
| U1 | 0.755 | | | |
| U2 | 0.878 | | | |
| U3 | 0.863 | | | |
| **IU** | | 0.841 | 0.904 | 0.760 |
| BIU 1 | 0.816 | | | |
| BIU 2 | 0.923 | | | |
| BIU 3 | 0.873 | | | |
| **ATT** | | 0.795 | 0.880 | 0.712 |
| ATT 1 | 0.873 | | | |
| ATT 2 | 0.942 | | | |
| ATT 3 | 0.801 | | | |

EoU: Ease of Use, PU: Perceived Usefulness, IU: Intention to Use, ATT: Attitude.

**Table 2.** Discriminant Validity of the Model

| Item | ATT | IU | EoU | PU |
|---|---|---|---|---|
| ATT | **0.844** | | | |
| IU | 0.764 | **0.872** | | |
| EoU | 0.641 | 0.603 | **0.815** | |
| PU | 0.832 | 0.867 | 0.622 | **0.834** |

Bold values: the square root of the average variance extracted (AVE) of each construct.

**Table 3.** Hypothesis testing results

| H | Path | Path Coefficient | t statistics | Support |
|---|---|---|---|---|
| H1 | EoU -> PU | 0.622*** | 8.124 | Supported |
| H2 | EoU -> ATT | 0.201*** | 2.071 | Supported |
| H3 | PU - > IU | 0.554*** | 4.724 | Supported |
| H4 | PU -> ATT | 0.707*** | 7.008 | Supported |
| H5 | ATT -> BIU | 0.754*** | 5.781 | Supported |

*** p < 0.1, ** p < 0.05,*** p < 0.01**

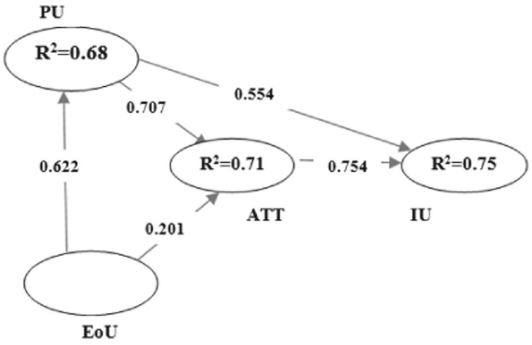


**Fig. 2.** The structural model results

Structural equation modeling was used to examine the newly added variables and their connections (Table 4). The calculation of the values produced findings that showed a good match of the structural model to the data for the specified research model [31].

It can be noticed that the values in the table are given within a range. The decision and direction of the result also confirms the validity of the proposed model.

**Table 4.** A summary of the results achieved is shown in the following table:

| Relationship | Path | t-value | p-value | Direction | Support |
|---|---|---|---|---|---|
| SQP → PU | – 0.006 | 0.114 | 0.914 | Neg | No |
| SQP → EoU | 0.103 | 2.498 | 0.011 | Pos | Yes |
| E → EoU | – 0.203 | 2.673 | 0.009 | Neg | Yes |
| E → IU | 0.133 | 2.112 | 0.035 | Pos | Yes |
| EoU → PU | 0.295 | 5.160 | 0.000 | Pos | Yes |
| EoU → ATT | 0.150 | 3.123 | 0.002 | Pos | Yes |
| PU → ATT | 0.522 | 9.697 | 0.000 | Pos | Yes |
| EoU → IU | 0.086 | 1.867 | 0.040 | Pos | Yes |
| PU → IU | 0.195 | 2.832 | 0.005 | Pos | Yes |
| ATT → IU | 0.341 | 5.132 | 0.000 | Pos | Yes |
| IU → Actual Usage | 0.192 | 3.486 | 0.001 | Pos | Yes |

Structural model results (significant at p** $< = 0.01$, p* $< 0.05$).

It is important to notice the accuracy of the proposed model in accordance to the results achieved in Table 4. For instance, in the proposed model System Quality Perception directly influences Ease of Use, in the previous table this hypothesis is confirmed since it shows a positive relationship between these two factors.

In a similar manner, in the proposed model a relationship between Ease of Use and Enjoyment was introduced, this relationship is also confirmed in the third row of

the table, showing a negative relationship between Enjoyment and Ease of Use. The direction is also consistent with the proposed model since it was proposed that Ease of Use influences Enjoyment and not the other way around, which is proven right in the structural model results.

Additionally, the last introduced relationship in the proposed model is also present in the results achieved. The fourth row of the table shows a positive relationship between Enjoyment and Intention to Use, which is precisely what the proposed model describes.

## 5 Discussion

Using the Technology Acceptability Model, this research investigates the acceptability of mobile-based teaching assessment (TAM). This is the first study to use the Technology Acceptance Model to assess mobile-based teaching (TAM). It adds to the theoretical body of knowledge in the area of mobile apps. The mindset of the user, according to the idea, is the most important element that affects their desire to use the MBTA. User attitude has a favorable and substantial effect on their intention to use the MBTA, according to the findings, accounting for 75% of the variance in user intention to use the MBTA. The result is that the user's intention has an impact on whether or not mobile-based teaching assessment (MBTA) is utilized, since a positive attitude leads to a greater willingness to use mobile-based teaching assessment (MBTA).

Furthermore, these results corroborate both hypotheses, and previous research has shown that the user's attitude influences their intention to utilize an e-learning system [28, 29]. TAM has a strong predictive value in describing how academic arena could be adopted mobile-based-teaching-assessment (MBTA) in the, according to the data. The purpose of users of mobile-based teaching assessment (MBTA) changes with their attitudes, according to TAM. As a result, users' attitudes and other associated variables that may enhance or reduce user acceptance of online educational tools must be given top priority in the success of such a model in the educational environment. Since TAM included attitude as the most important main explanatory variable, the study recommends that variables that increase attitude be studied in the future.

Through the mediation of attitude, the ease of use has a substantial beneficial impact on the intention to use. Students and academic support staff develop a strong proclivity to utilize MBTA with ease as they get a better understanding of mobile apps in teaching assessments. The MBTA's perceived utility (PU) has a direct positive impact on the desire to use it. Students and support groups have a greater conviction in the use of mobile applications in teaching assessment as an alternate or complementary method to paper-based and computer-based assessment delivery modalities that may be used both within and outside of the school.

## 6 Conclusions

The implications of this study include motivation of both students and academic support groups to perform the teaching assessment for their convenience and encourage developer should design mobile applications that appeal needs of students and academic support groups on one side and education administration on the other. Implementation

of teaching assessment based on mobile applications depends on the positive attitude of the administration.

Although the current research represents an early effort at developing MBTA acceptability, it does not imply that it is without limits. The present proposed model calls to be tested to other theories than TAM. It further needs to account for individual differences among users of mobile applications in teaching assessment. For future research, proposed model calls for applying in other settings as well as adding additional variables.

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