

Mobile Learning-system usage: An integrated framework to measure students' behavioural intention

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Abstract—Mobile technologies have changed the shape of learning for learners, society, and education providers. Consequently, mobile learning has become a core component in modern education. Nevertheless, introducing mobile learning systems does not automatically guarantee that learners will develop a positive behavioural intention to use it and therefore use it. Thus, acceptance-of-technology and system-success studies have increased. As yet, however, much of the research regarding understanding students' behavioural intention to use mobile learning systems seems to suffer from several shortcomings. On top of that, there is no common cognitive theoretical foundation. This study introduces a theoretical framework that combines the Unified Theory of Acceptance and Use of Technology (UTAUT) and information system (IS) success model. This integration resulted in three success measures and two acceptance constructs. The success measures included the following: a) information quality, b) system quality, and c) user satisfaction; whilst the following were the acceptance measures: a) effort expectancy, b) performance expectancy, and c) social influence. Further, this study introduces lecture attitude as a new construct that is believed to moderate students' behavioural intention. The relationships between the different factors form the research hypotheses.

Keywords—Mobile learning; Mobile learning; Higher education; UTAUT; IS Success

I. INTRODUCTION

Knowledge acquisition is no longer restricted to a certain place and time. In fact, there is a rapid change taking place to traditional learning methods[1]. Learning in the 21st century, or the digital age, is affected by the rapid development of information and communication technologies and the availability of low-cost mobile devices[2] (mobile laptops, tablets, smart phones, PDAs, etc.), and this has resulted in mobile devices becoming more pervasive. Mobile learning is not yet well defined in the literature due to the argument regarding whether to focus on the mobility of learners or devices.

Further, it is argued that mobile learning is defined from a technical perspective instead of through the consideration of pedagogical elements. Generally, mobile learning is defined as the conducting of educational activities using a mobile device and wireless service in which both learner and device are mobile[3].

For learners, a mobile-learning environment assists in accessing content quicker, allowing collaborative learning, improving communication between learners, and allowing learners to conduct study-related activities from different locations[4]. For education providers, there have been various initiatives investigating the proliferation and role of the mobility of devices and learners. Therefore, the acceptance and success of mobile Learning-systems, as they are Information Systems in nature, have drawn researchers' attention.

The main purpose of this paper is to develop a framework that assists in understanding students' behavioural intention to use mobile Learning-systems in a higher-education setting. The rest of this paper is structured as follows: First, literature reviews about previous models and theories that have been used to understand the intention and acceptance of an IS are discussed. Second, the two models used in this paper are presented, namely the Unified Theory of Acceptance and Use of Technology[5] and the DeLone and McLean model(D&M henceforth)[6, 7]. Third, the research model and hypotheses development are described. Finally, the outline for the research method is elaborated. Additionally, this paper hopes to contribute to the work in developing a framework that can be used with students' intention to use mobile Learning-systems.

II. ACCEPTANCE, THEORIES AND MODEL

Reviewing the relevant literature reveals that investigating Information-System (IS) acceptance has received great attention during the last three decades. Among these models, research such as [8] cited eight models that explain human behaviour and predict IS acceptance: the theory of reasoned action (TRA) [9]; then, based on TRA, Davis [10] introduced the technology acceptance model (TAM); the theory of planned behaviour (TPB) [11]; the motivational model (MM) [12]; the social cognitive theory (SCT) [13, 14]; a combination of TAM and TPB (C-TAM-TPB) [15]; the model of PC utilisation (MPCU)[16, 17]; and the innovation diffusion theory (IDT) [18, 19]. TRA is suggested to be a fundamental theory in understanding human behaviour. In TRA, behaviour and intention are influenced by two main constructs: attitude about behaviour and subjective norms[9]. Following TRA, TAM was introduced to help understand users' acceptance and usage of a given IS[10]. In TAM, perceived ease of use and perceived usefulness are the core constructs that affect users' attitude and intention, and therefore their use of IS.

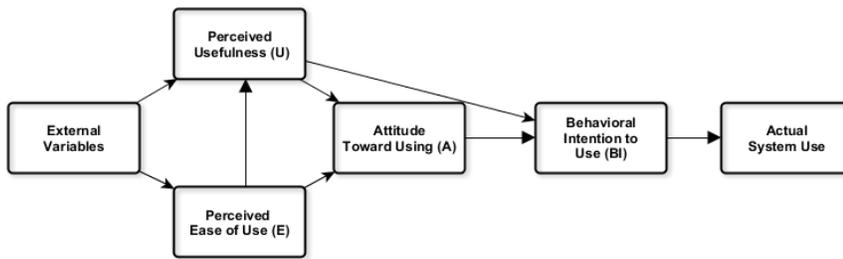


Fig. 1. Technology Acceptance Model (TAM) [10]

Based on a research conducted by [10] the extended TAM, known as the unified theory of acceptance and use of technology (UTAUT), was introduced. UTAUT constructs are derived from the eight models mentioned above [8]. In terms of measuring IS success, in their research, Wang and Shee [20] cited that the D&M model on IS success [6, 7] appears frequently in system-success studies [21-23].

In this paper, the IS-success model and UTAUT are combined to provide the research-model construction and hypothesis formulation. In the following section, both the UTAUT and IS-success models are introduced in more detail.

A. Unified Theory of Acceptance and Use of Technology

The UTAUT [5] attempted to unify previous theories, as there was an argument about similarities in variables that predicted IS acceptance introduced within these models in different terminologies [24]. UTAUT, as shown in Fig.1, suggests that four core constructs, namely performance expectancy, effort expectancy, social influence, and facilitating conditions affect users' behavioural intention and use behaviour. It also incorporates four other variables: gender, age, experience, and voluntariness of use that [5] highlight to moderate users' adoption of an IS.

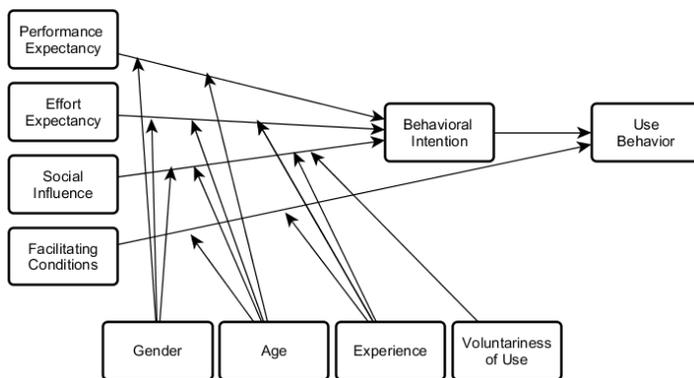


Fig. 2. Unified Theory of Acceptance and Use of Technology (UTAUT) [5]

Using these eight determinants in UTAUT, it is evident from the literature that UTAUT is able to explain 70% of technology acceptance behaviour [5, 25, 26]. Further, UTAUT has received researchers' attention to empirically validate the model, and it has been successfully tested in the realm of mobile-technology adoption, which is similar to the scope of this study [27] [28] [24] [8, 26]. As shown in Fig.2, it is clear that TAM [10] provides the basis for UTAUT. The original TAM suggests that the acceptance or rejection of an IS can be

measured based upon two beliefs: perceived usefulness and perceived ease of use. Perceived usefulness (PU) is defined as "the degree to which a person believes using a particular system would enhance his or her job performance" [10], and the other belief is "perceived ease of use" (PEOU), which is defined as "the degree to which a person believes that using a particular system would be free of effort" [10].

Within UTAUT, the two prominent beliefs in TAM are similar to performance expectancy and effort expectancy, respectively. The other constructs are 1) social influence, which directly affects behavioural intention to use the IS and 2) facilitating conditions, which directly impacts use behaviour. Within the current research interest and focus, the direct determinates of behavioural intention are used to avoid incorrect inference. Thus, facilitating condition was eliminated from the proposed model, as it is not a direct determinate on behavioural intention to use [5]. Further, age and gender are adopted as moderators for the intention. However, the other two variables, experience and voluntariness of use, suggested by UTAUT are omitted because experience moderates user behaviour, and the current study investigates mobile learning in a voluntary-usage environment. Moreover, because the research goal is to measure students' behavioural intention to use mobile Learning-systems, the use behaviour in UTAUT [5] and use in the D&M [6, 7] model are also eliminated.

B. IS Success model

D&M [6] proposed a model for measuring IS success. After a comprehensive review of relevant literature regarding IS success measures, D&M concluded that IS success can be measured using a multidimensional model that adopts six different success categories: system quality, information quality, use, user satisfaction, individual impact, and organizational impact (see Fig.3).

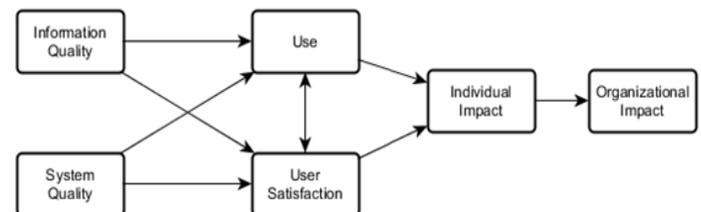


Fig. 3. D&M IS Success Model [6]

System quality and information quality affect use and user satisfaction. Further, user satisfaction can be affected by the amount of use and vice versa. Use and user satisfaction jointly and separately have a direct association with individual impact.

Finally, individual impact is a direct antecedent of organisational impact. Hence, the D&M model essentially provides a multitude of IS-success measures and proposes temporal and causal interdependencies between quality characteristics (system quality); IS-output quality (information quality); output consumption (use); users' response (user satisfaction); behavioural effects of the IS on users (individual impact); and, lastly, IS effects on organisational performance (organisational impact)[29, 30]. The relationship between the six categories has been empirically investigated by many researchers (e.g., [29-32]).

In response to suggestions from the literature and evidence from empirical studies, an updated IS-success model was proposed [7]. In the updated IS-success model, DeLone and Mclean [7] introduced "service quality" as a new measurement, and both individual and organisational impacts were grouped into a new category called "net benefits" (see Fig.4).

In this research, the categories adopted from the updated IS Success model [7] are explained in the research-model section.

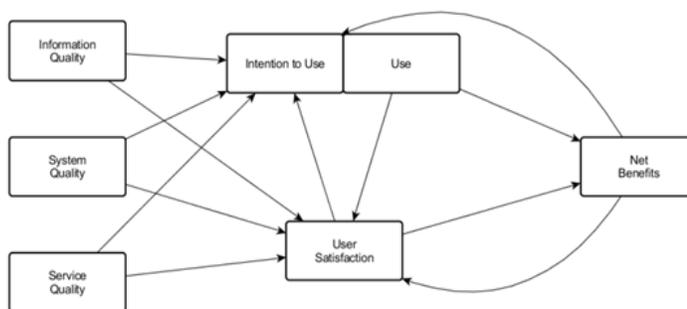


Fig. 4. Updated D&M IS Success Model[7]

III. RESEARCH MODEL

Various types of models have been applied to the context of mobile learning in order to understand and explain students' use of mobile learning and their satisfaction about mobile Learning-systems. In a mobile-learning context, however, there is a gap in the literature with regard to providing a theoretical framework in which empirical research can be grounded[33, 34]. In addition, Sun and Zhang [35] highlight that previous theories can be further improved. Most importantly, in their research to validate D&M model (Rai, Lang, & Welker, [36] recommended integrating theories and developing a multi-constructs model that considers beliefs, attitude, and behaviour in addition to IS-success measures. Therefore, the research model, as shown in Fig.5, in this research combines constructs from UTAUT [5] and success categories from the D&M model[7]. And it also introduced a new moderator found in the literature of mobile and eLearning: lecturer attitude.

The following subsection provides a comprehensive look at the theoretical groundwork provided by prior studies in order to formulate relevant hypotheses.

A. The relationship between UTAU constructs and behavioural intention

As discussed earlier, and in accordance with the current study objectives, the three core constructs in UTAUT have been adopted in this study.

These constructs include performance expectancy, effort expectancy, and social influence. This is because they directly impact behavioural intention. However, the fourth construct, which is facilitating conditions, is eliminated from the current study due to the absence of its effect on behavioural intention[5]. The moderators used in this study are gender and age, which have been found to moderate UTAUT constructs[8]. Therefore, in relation to UTAUT variables, six hypotheses were introduced in this study.

1) Performance expectancy

First, performance expectancy replaced determinants found in other models (Table 1). In this study, performance expectancy is defined as the "degree to which a student believes that using mobile learning systems is helpful, useful and helps him/her to do tasks quickly, and attain gain in learning outcomes". In addition, performance acceptance is a direct determinant of a user's behavioural intention to use an IS, thus it can be validated[5]. Therefore, the following is hypothesised:

a) H1: Performance expectancy would positively affect students' behaviour intention to use mobile Learning-systems.

b) H2: Age and gender would moderate the relationship between performance expectancy and behaviour intention to use.

2) Effort expectancy

Second, effort expectancy, which is also proposed in UTAUT, combines other variables (Table 1). Within this study, effort expectancy is referred to as "the degree of ease associated with the use of mobile Learning-systems: the ease of using the systems, the flexibility of interaction, and interaction with mobile Learning-systems is clear and understandable". Effort expectancy is already validated to have a direct impact on a user's behavioural intention to use IS[5]. Therefore, hypotheses on the relationship between effort expectancy and behavioural intention, and the effect of gender and age are as follows:

a) H3: Effort expectancy would positively affect students' behaviour intention to use mobile Learning-systems.

b) H4: Age and gender would moderate the relationship between effort expectancy and behaviour intention to use.

3) Social influence

Further, the linkage between the third construct, social influence, is examined. Considering the current study context, social influence is defined as the "degree to which a student perceives the importance of others believe he or she should use mobile Learning-system". Similar to the previous constructs, social influence is empirically tested to be used as a direct determinate of a user's intention to use an IS[5]. Therefore, the following is the hypotheses on the relationship between social influences and behavioural intention and the effect of gender and age:

a) H5: Social influence would positively affect students' behaviour intention to use mobile Learning-systems.

b) H6: Age and gender would moderate the relationship between social influence and behaviour intention to use.

TABLE I. ADAPTED FROM[5], CITED IN[25]

UTAUT Constructs	The Sub-Constructs	The source theory/ies
<i>Performance Expectancy</i>	Perceived Usefulness	TAM/TAM2/C-TAM-TPB
	Extrinsic Motivation	MM
	Job-Fit	MPCU
	Relative Advantage	IDT
	Outcome Expectations	SCT
<i>Effort Expectancy</i>	Perceived Ease of Use	TAM/TAM2
	Complexity	MPCU
	Ease of Use	IDT
<i>Social Influence</i>	Subjective Norm	TRA, TAM2, TPB/DPTB, C-TAM/TPB
	Social Factors	MPCU
	Image	IDT

B. Success measures

Success measures vary from one IS to another. Stockdale and Borovicka [37] states that success measures are influenced by the type of system being evaluated. Thus, it is important to relate the context of the IS to the appropriate success measure[38]. In this study, information and system quality are adapted from [7]. In addition, a finding from Wixom and Todd [39] is discussed.

According to DeLone and McLean [6, 7], information quality is the quality of the output of the IS. It considers the completeness and whether the IS provides all relevant information. Further, information quality is measured by the format and information presentation. Accuracy and correctness of information are also included in information quality measure. Accuracy concerns data correctness; currency assess

whether the information is up to date.

The other success measure in the D&M model, system quality, measures the functionality and performance of the IS [7]. System quality considers various dimensions of the IS, such as reliability, flexibility, accessibility, and usefulness.

It has been found in the literature that validates the D&M model[7] that information quality and system quality jointly or separately affect user satisfaction—the user’s response to the IS[40-42]. Consequently, user satisfaction also affect the user’s intention to use the IS[6, 7].

Therefore, based on the discussion above, the following is hypothesised:

- a) H7: Information quality would positively affect students’ satisfaction about mobile Learning-systems.
- b) H8: System quality would positively affect students’ satisfaction about mobile Learning-systems.
- c) H9: Students’ satisfaction would positively affect students’ intention to use mobile Learning-systems.

Further, Seddon and Kiew[40] revised the D&M model and replaced use with usefulness. The authors concluded that system usefulness positively impacts the actual use. However, not using the system does not automatically mean it is not useful. In addition, in a research on theoretical integration of user satisfaction and technology acceptance, Wixom and Todd [39] introduced two measures: information satisfaction and system satisfaction. The former measures the satisfaction with information produced by the system. The latter addresses the degree of favourableness with regard to the system and interaction mechanism.

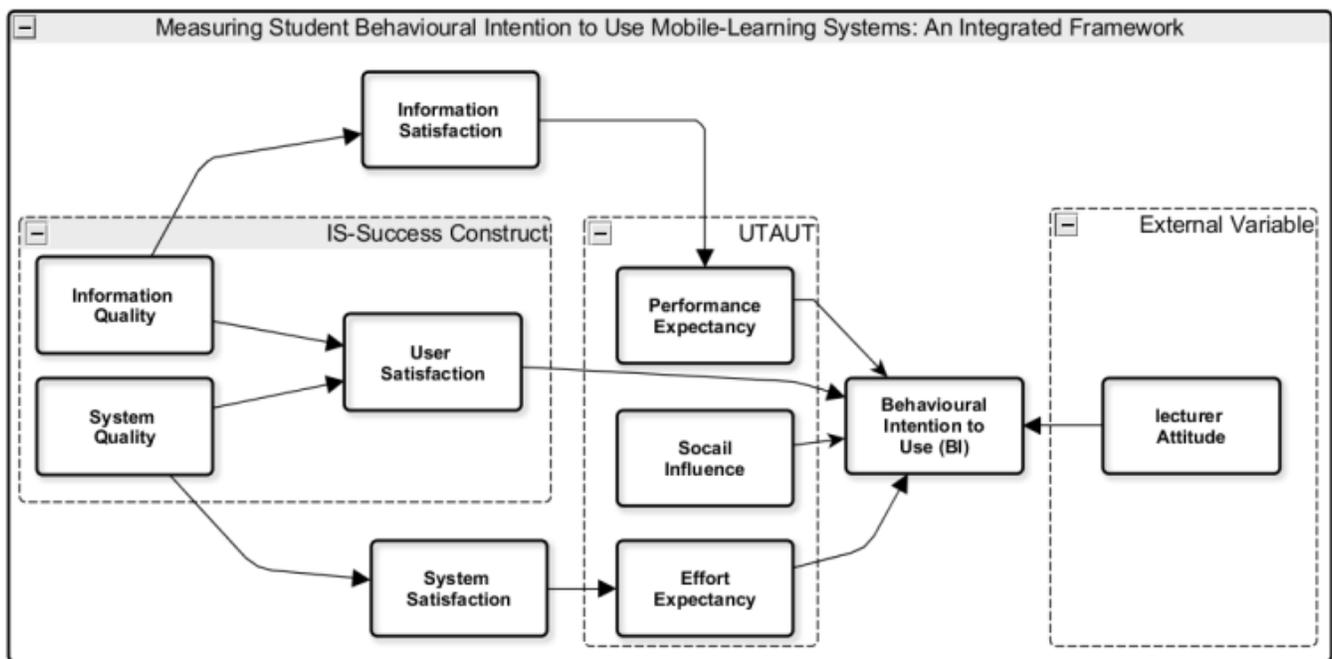


Fig. 5. The research model

In their conclusion, the authors highlights that information and system satisfaction are directly affected by information and system quality, respectively. In addition, the more information satisfaction, the more likely one will find the IS useful. In the same vein, the more system satisfaction, the more likely one will find an IS easy to use. It is noteworthy that usefulness and ease of use are the main constructs in TAM. However, as UTAUT is employed in this study instead of TAM, the performance expectancy and effort expectancy are used. They capture usefulness and ease of use, respectively[5].

Therefore, the discussion above led to the following hypothesis:

d) H10: Information quality would positively affect information satisfaction of mobile Learning-systems.

e) H11: System quality would positively affect system satisfaction of mobile Learning-systems.

f) H12: Information satisfaction would positively affect performance expectancy.

g) H13: System satisfaction would positively affect effort expectancy.

C. The relationship between introduced construct and behavioural intention

In a study of acceptance of mobile learning, Wang, et al. [8] highlights that the mobile-learning context is not necessarily similar to other IS, and therefore UTAUT core constructs may not be sufficient in determining a user's behavioural intention. Further, Pedersen and Ling [43], as cited in Wang, et al., [8], suggest to modify existing models in order to apply them to mobile Internet services, including mobile learning. Therefore, an additional construct was incorporated in this study: lecturer attitude.

1) Lecturer's attitude

Very little research focuses on addressing the impact of instructors' opinions on students' behavioural intention to use mobile devices in learning. Researchers such as Brubaker [44] investigated instructors' attitudes towards using laptop devices during lectures; the result reveals that a majority of respondents emphasise that laptops distract students. A recent study on students' perceptions confirms the finding. The recent qualitative study by Gikas and Grant [45] reflects that students are frustrated because of anti-technology instructors who are unwilling to incorporate technology into their courses. By contrast, [46] studied faculty perception in using mobile devices in their classes, and the result showed that lecturers may have a positive believe on students using mobile devices.

Therefore, from the discussion above, researchers believe that lecturers' attitudes could affect students' behavioural intention to use mobile Learning-systems. Hence, the following is hypothesised:

a) H14: Lecturers' attitude toward using mobile devices would positively or negatively affect students' behaviour intention to use mobile Learning-systems.

IV. METHODOLOGY

A quantitative empirical method will be used to validate the research model. The necessary data for the model validation will be collected using an online survey. Further explanation and verification of the model constructs will be undertaken. The development of the scale will be based on previously-validated scales available from relevant literature. Specifically, the questionnaire will be constructed from the original UTAUT model[5] and IS success model[6, 7].

Further, for other measures proposed by authors, experts from the mobile-learning field will be contacted to ensure content validity. The participants in this research will be undergraduate and postgraduate students from different faculties and disciplines. Participants will be recruited by emailing the URL to the questionnaire. A probability-sampling technique, particularly random sampling, will be utilized in this study to achieve the sample frame. An SPSS software package will be used to accomplish proper statistical processing and therefore determine significant relationships between the different variables within the research model.

V. CONCLUSION AND FUTURE WORK

This paper has explored acceptance theories and success models and their usage in mobile-learning context in higher-education. Despite the wide spread of mobile Learning-systems adoption, It has been noticed that there is a lack in investigating student behavioural intention to use such systems. Therefore this study proposes an integrated framework to measure student behavioural intention to use mobile Learning-systems.

This framework combines an acceptance theory (UTAUT), and an IS-Success model (D&M). Constructs adapted from UTAUT are: 1) performance expectancy, 2) effort expectancy, and 3) social influences. Further, constructs adapted from D&M model are: information quality, 2) system quality, and 3) system satisfaction. Moreover, two additional constructs were found in the literature, namely, information satisfaction and system satisfaction. In addition, lecturers' attitude is introduced in this research. In the near future, the researchers plan to develop a scale to validate the proposed framework as described in the methodology section.

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