Mobile Learning-system usage: Scale development and empirical tests

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. The methodology section provides comprehensive details about the research instruments, constructs validation, sampling and the outline for the research method, data collection, and analysis tools are elaborated. The Data analysis and the discussion follow the methodology section where the research hypotheses were examined, and the results were discussed. 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].

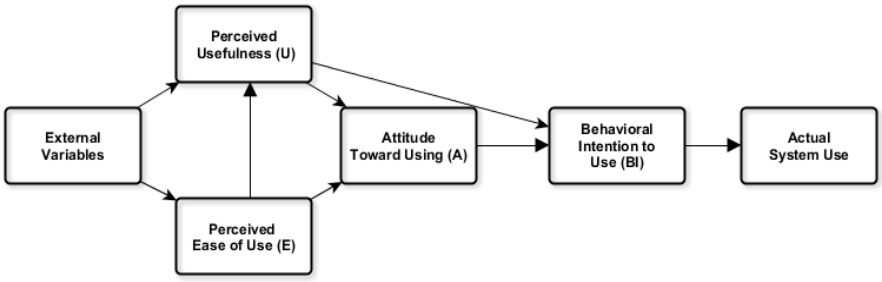

Fig.1. Technology Acceptance Model (TAM) [10]

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.

Based on a research conducted by Davis [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 Wang, et al. [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. Our research has two objectives. First, we suggest a framework that can be used to measure students behavioural intention to use mobile-learning systems. The second objective is to examine the relationship between the various variables and students' behavioural intention to use such systems.

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.2, suggests that four core constructs, namely performance expectancy, effort expectancy, social influence, and facilitating conditions affect users' behavioural intention and use behaviour. It also incorporate four other variables: gender, age, experience, and voluntariness of use that [5] highlight to moderate users' adoption of an IS.

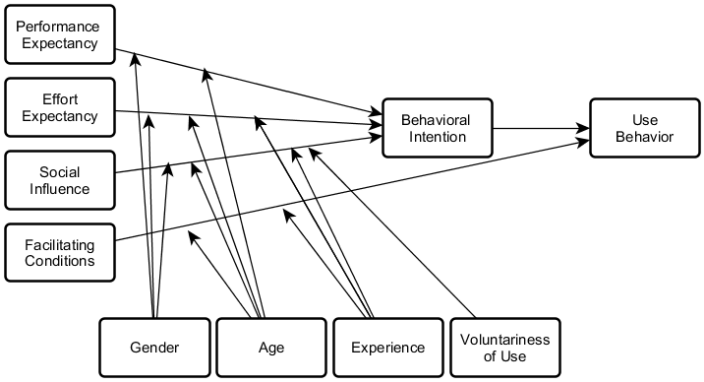

Fig.2. Unified Theory of Acceptance and Use of Technology (UTAUT)[5]

Using these eight determinants in UTAUT, it is evident from the literature that UTAUT is able to explain approximately 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.1. 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 determinants of behavioural intention are used to avoid incorrect inference.

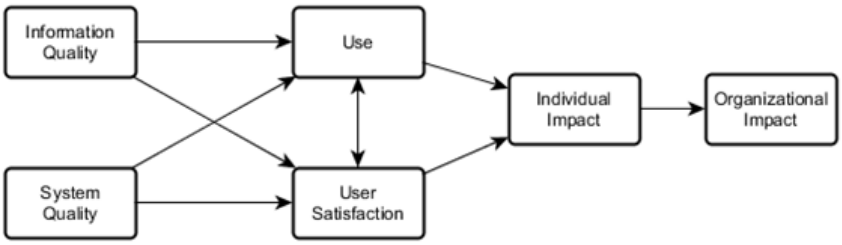

Fig.3. D&M IS Success Model[6]

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 also removed for simplicity, and 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).

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.

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.

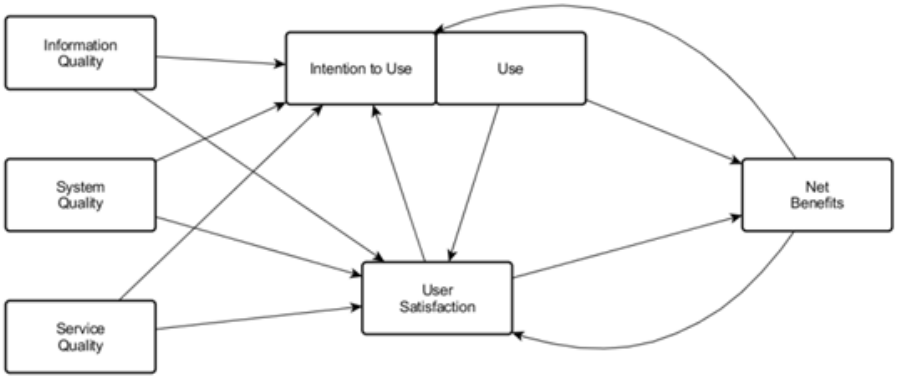

Fig.4. Updated D&M IS Success Model[7]

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 introduces a new moderator found in the literature of mobile and eLearning: lecturer attitude. The following subsections provide a comprehensive look at the theoretical groundwork provided by prior studies in order to formulate relevant hypotheses for this research.

A. The relationship between UTAUT 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]. Therefore, in relation to UTAUT variables, three hypotheses were introduced in this study.

1) Performance expectancy

First, performance expectancy replaced determinants found in other models (Table I). 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.

2) Effort expectancy

Second, effort expectancy, which is also proposed in UTAUT, combines other variables (Table I). 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 are as follows:

a) H2: Effort expectancy would positively affect students' behaviour intention to use mobile Learning-systems.

3) Social influence

Further, the linkage between the third construct, social influence, and behavioural intention 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:

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

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

UTAUT Constructs	The Sub-Constructs	The source theory/ies
Performance Expectancy	Perceived Usefulness	TAM/TAM2/C-TAM-TPB
	Extrinsic Motivation	MM
	Job-Fit	MPCU
	Relative Advantage	IDT
	Outcome Expectations	SCT
Effort Expectancy	Perceived Ease of Use	TAM/TAM2
	Complexity	MPCU
	Ease of Use	IDT
Social Influence	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 DeLone and McLean [7]. In addition, findings 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) H4: Information quality would positively affect students' satisfaction about mobile Learning-systems.

b) H5: System quality would positively affect students' satisfaction about mobile Learning-systems.

c) H6: Students' satisfaction would positively affect students' intention to use mobile Learning-systems.

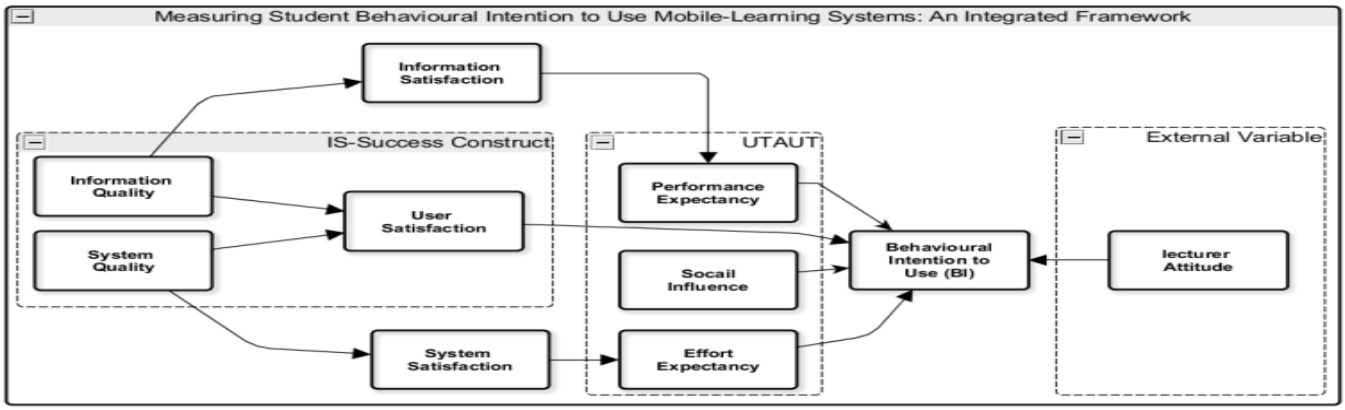

Fig.5. The research model

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. In their conclusion, the authors highlight 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) H7: Information quality would positively affect information satisfaction of mobile Learning-systems.

e) H8: System quality would positively affect system satisfaction of mobile Learning-systems.

f)H9: Information satisfaction would positively affect performance expectancy.

g) H10: System satisfaction would positively affect effort expectancy.

C. The relationship between the 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, Alsaggaf, et al. [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) H11: Lecturers' attitude toward using mobile devices would positively affect students' behavioural intention to use mobile Learning-systems.

IV. METHODOLOGY

A quantitative empirical method is used to validate the research model. From a methodological point of view, a survey is used within this research to accomplish the study objectives[47, 48].First, this study is based on well-tested and validated research instruments in previous similar researches. Further, this study objectively investigates the relationships between various constructs, therefore using survey as method for data collection enables testing the research hypotheses. The necessary data for the model validation is collected using an online survey. Online surveys provide researchers with various benefits[49], including saving researchers time and reducing expenses by overcoming geographic distance. Further, online surveys enable recruiting unique subjects.

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 were 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, is utilized in this study to achieve the sample frame. Random sampling is used when each unity in the population has the chance to participate[50]. SPSS software package is used to accomplish proper statistical processing and therefore determine significant relationships between the different variables within the research model.

A. Survey population

Participants in this project were any person enrolled in any undergraduate or postgraduate degree at Griffith University, Australia. The potential participant pool includes students from any level of study and including on-campus and off-campus students. That includes those who are currently doing their English course at Griffith English Language Centre. Participants were recruited by word of mouth, and via email during which official calls for participation were issued.

B. Instrument development

To ensure content validity, the questionnaire used in this study was adapted from the original measurement scales used in UTAUT model[5], IS success model[6, 7], Modified IS Success[40], and on the basis of literature review, the lectures' attitude is added as a new construct. The necessary modifications and wording changes and validation was made to fit the context of mobile learning context. To avoid issues that can occur in wordings, measurement and ambiguities, the questionnaire was pre-tested by two native English speakers. Sekaran and Bougie [51] highlight that such pre-test is essential because wording problems significantly influence accuracy[52].

The research instrument consists of five main sections. The first section incorporates a nominal scale to identify respondents' demographic information. The second section to the fifth section uses 7-point Likert response scale where 7: Strongly agree, 6: Moderately agree, 5: Slightly agree, 4: Neutral, 3: Slightly disagree, 2: Moderately disagree, and 1: Strongly disagree.

The second section concerns UTAUT constructs. IS Success items are presented in the third section. The fourth section consists of the Modified IS Success variables. Finally, the introduced variables, lecturer's attitude is included in the fifth section. The sections from two to five are presented in the Table 2 below with the subsections for each model. The full questioner, including the demographics information is available in Appendix A.

TABLE.II. RESEARCH INSTRUMENTS

Mobile Learning-system usage: An integrated framework to measure students' behavioural intention *Scales and items*	
2. UTAUT(adapted from Venkatesh, Morris, Davis, & Davis (2003)**)**	
Section I	**Performance Expectancy**
PEE1	I feel that mobile learning is useful.
PEE2	Mobile learning improves my study efficiency.
PEE3	Mobile learning improves my study convenience.
PEE4	Mobile learning lets me do study related tasks more quickly.
Section I	**Effort Expectancy**
EFE1	Skilfully using mobile learning is easy for me.
EFE2	I find that using mobile learning is easy.
EFE3	Learning how to use mobile learning is easy for me.
EFE4	My interaction with mobile learning is clear and understandable.
Section III	**Social Influence**
SOI1	Those people that influence my behaviour think that I should use mobile learning
SOI2	Those people that are important to me think that I should use mobile learning
Section IV	**Behavioural Intention to Use**
BI1	I intend to use the mobile learning system in the future
BI2	I predict I would use the mobile learning system in the future
BI3	I plan to use the mobile learning system in the future
3. IS Success (adapted from DeLone & McLean (1992,2003)**)**	
Section I	**Information Quality**
IQ1	The mobile learning system provides information that is exactly what you need (Content Accuracy)
IQ2	The mobile learning system provides information you need at the right time (Availability)
IQ3	The mobile learning system provides information that is relevant to your course (Usability, relevance)
IQ4	The mobile learning system provides sufficient information for your purposes (Quantity of information)
IQ5	The mobile learning system provides information that is easy to understand (Understandability)
IQ6	The mobile learning system provides up-to-date information (Currency)
IQ7	The mobile learning system provides information that appears readable, clear and well formatted (User interface)
IQ8	The mobile learning system provides required information on time. (Timeliness)
IQ9	The mobile learning system provides information that is suitably concise.
Section II	**System Quality**
SQ1	The mobile learning system allows a high level of customization for different courses
SQ2	The mobile learning system provides for personalized information presentation
SQ3	The mobile learning system is easy to use
SQ4	The mobile learning system is user-friendly (Easy to learn)
SQ5	The mobile learning system provides a high of availability (Access)
SQ6	The mobile learning system provides an appropriate level of on-line assistance and explanation (User requirements)
SQ7	The mobile learning system provides interactive features for an effective user experience

SQ8	The mobile learning system provides satisfactory support to users of the system (Help and training)
SQ9	The mobile learning system has features that support the needs of a range of different courses (Flexibility)
SQ10	The mobile learning system has a high level of reliability
SQ11	The mobile learning system provides high-speed information access (Efficiency)
4. Modified IS Success(Adapted from Seddon and Kiew(2007)**)**	
Section I	**User Satisfaction**
US1	Mobile learning systems is effective
US2	Mobile learning systems is efficient
US3	Overall, I am satisfied with mobile learning systems
Section II	**Information Satisfaction**
IS1	Overall, the information I get from mobile learning system is very satisfying
IS2	I am very satisfied with the information I receive from mobile learning system
Section III	**System Satisfaction**
SS1	All things considered, I am very satisfied with mobile learning system
SS2	Overall, my interaction with mobile learning system is very satisfying
5. Lecturers' attitude (New scale**)**	
Section I	**Lecturers' attitude**
LT1	I can use my mobile device in a formal learning environment e.g. searching resources in lectures
LT2	Lectures encourage me to use mobile devices device in a formal learning environment e.g. searching resources in lectures
LT3	Lecturers say that mobile devices sometimes can be very distracting.

C. Data Collection

The questionnaire was made available at the first semester of the academic year 2014. The survey was distributed online by emailing the potential population the URL to the survey. At this time, 204 responses were recorded. Of that, only 124 responses yielded valid responses that were used for analysis.

D. Reliability

Reliability assessment was done using Cornbach Alpha[53]. Reliability concerns internal consistency between multiple measurements of variables, and Cornbach Alpha is commonly used to measure it[54]. As per many studies(i.e.,[55, 56], constructs are considered to have internal consistency reliability when the Cronbach Alpha value exceeds 0.07.

In this study, the reliability assessment was done using Statistical Package for Social Sciences (SPSS) version 22. All measures in this study show a high level of reliability, ranging from 0.924 to 0.981. All scales exceeded 0.70, and therefore the survey is considered reliable. However, the new introduced scale, lecturer attitude shows a low reliability score of .63 which suggest that this construct needs further revision. Further, according to De Vaus [57] reliability score might be attributed to the smaller number of items. The table below (Table III) summaries the reliability analysis for all constructs. The overall reliability for all scales exceeded 0.70, and therefore the survey is considered reliable.

TABLE.III. RELIABILITY ANALYSIS

Scale	Number of Items	Cronbach Alpha
Performance Expectancy (PEE)	4	0.924
Effort expectancy (EFE)	6	0.960
Social Influence (SOI)	2	0.958
Behavioural intention to use (BIU)	3	0.973
Information Quality(IQ)	9	0.958
System Quality(SQ)	11	0.963
User Satisfaction (US)	3	.958
Information Satisfaction (IS)	2	.960
System Satisfaction (SS)	2	.981
Lecturer Attitude (LT)	3	.63
Overall reliability	43	0.98

E. Ethics

This research is being conducted in accordance with the ethics requirements by the relevant research ethics committee. Prior to the commencement of the data collection stage, ethical approval was obtained. Before commencing the survey, a full disclosure of the research title, purpose, expected benefits, and the ethical conducts of the research was provided to all participants. Further, participants were made aware of the voluntary participation in which they do not have to answer every question unless they wish do so, and they may withdraw at any stage of the questionnaire. In addition, data was collected anonymously and no personal information about the subjects were collected. The confidentiality of the data collected was assured to all participants. Finally, participants were provided with the researchers' information and contact details, and the research ethics committee contact details for any inquiry.

V. DATA ANALYSIS

A. Demographics

Most of the participants were female, 77 % females and 32 females. The majority of participants were between 18 and 24 years, with 50.81 % from 18 to 24, 24.19% from 25 to 34, 13.71% from 35 to 44, and 11.29% range from 17 to 18, and above 44. The rest of demographic information regarding the level of education, device types, the various use of mobile devices, and the use of Griffith mobile app are presented in the figure presented in the next page (Fig. 6).

B. Statistical analysis and hypotheses testing

In line with the study objective, correlation analysis was conducted to examine the relationship between the variables used within this study, and therefore to empirically decide whether or not to accept or reject the null hypotheses. The strength of correlation coefficients is determined based on the categorisation proposed by Dancey and Reidy [58] as follows: a)perfect correlation(1), b) Strong (0.7-0.9), c) Moderate(0.4-0.6), d) Weak(0.1-0.3), e) Zero(0).

Hypotheses on the relationship between UTAU constructs and behavioural intention are presented first.

1) The relationship between UTAUT constructs and behavioural intention

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

The correlation analysis result in Table IV below shows that there is a strong positive relationship between PE and BIU and this correlation is significant, r(124) =.828, p < .005. This correlation suggests that when performance expectancy increases, students' behavioural intention to use mobile-learning systems will increase. Hence, H1 is supported.

TABLE.IV. PE AND BIU CORRELATIONS

Correlations		
Factors		BIU
PE	r-value	.828**
	p-value	.000
	N	124

PE: Performance expectancy; BIU: Behavioural intention to use

b) H2: Effort expectancy would positively affect students' behaviour intention to use mobile Learning-systems.

The correlation analysis result in Table V below shows that there is a fairly strong positive and significant relationship between EF and BIU, r(124) =.664, p < .005. This correlation suggests that when effort expectancy increases, students' behavioural intention to use mobile-learning systems will increase. Hence, H2 is supported.

TABLE.V. EF AND BIU CORRELATIONS

Correlations		
Factors		BIU
EF	r-value	.664**
	p-value	.000
	N	124

EF: Effort expectancy; BIU: Behavioural intention to use

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

The correlation analysis result in Table VI below shows that there is a fairly a weak positive relationship between SOI and BIU, r(124) =.323, p < .005. Since the correlation is significant, H3 is statistically supported.

TABLE.VI. SOI AND BIU CORRELATIONS

Correlations		
Factors		BIU
SOI	r-value	.323*
	p-value	.000
	N	124

SOI: Social influence; BIU: Behavioural intention to use

2) The relationship between Success measures constructs and behavioural intention

a) H4: Information quality would positively affect students' satisfaction about mobile Learning-systems.

The correlation analysis result in Table VII below shows that there is a fairly strong positive and significant relationship between IQ and SS, r(124) =.870, p < .005. This correlation suggests that when information quality increases, students' satisfaction about mobile-learning systems will increase. Hence, H4 is supported.

TABLE.VII. IQ AND SS CORRELATIONS

Correlations		
Factors		SS
IQ	r-value	.870**
	p-value	.000
	N	124

IQ: Information Quality; SS: System Satisfaction

3) The relationship between Success measures constructs and behavioural intention

a) H4: Information quality would positively affect students' satisfaction about mobile Learning-systems.

The correlation analysis result in Table VII below shows that there is a fairly strong positive and significant relationship between IQ and SS, r(124) =.870, p < .005. This correlation suggests that when information quality increases, students' satisfaction about mobile-learning systems will increase. Hence, H4 is supported.

TABLE.VIII. IQ AND SS CORRELATIONS

Correlations		
Factors		SS
IQ	r-value	.870**
	p-value	.000
	N	124

IQ: Information Quality; SS: System Satisfaction

b) H5: System quality would positively affect students' satisfaction about mobile Learning-systems.

The correlation analysis result in Table VIII below shows that there is a strong positive and significant relationship between IQ and US, r(124) =.825, p < .005. This correlation suggests that when system quality increases, students' satisfaction about mobile-learning systems will increase. Hence, H5 is supported.

TABLE.IX. SQ AND BIU CORRELATIONS

Correlations		
Factors		US
SQ	r-value	.825**
	p-value	.000
	N	124

SQ: System Quality; US: User Satisfaction

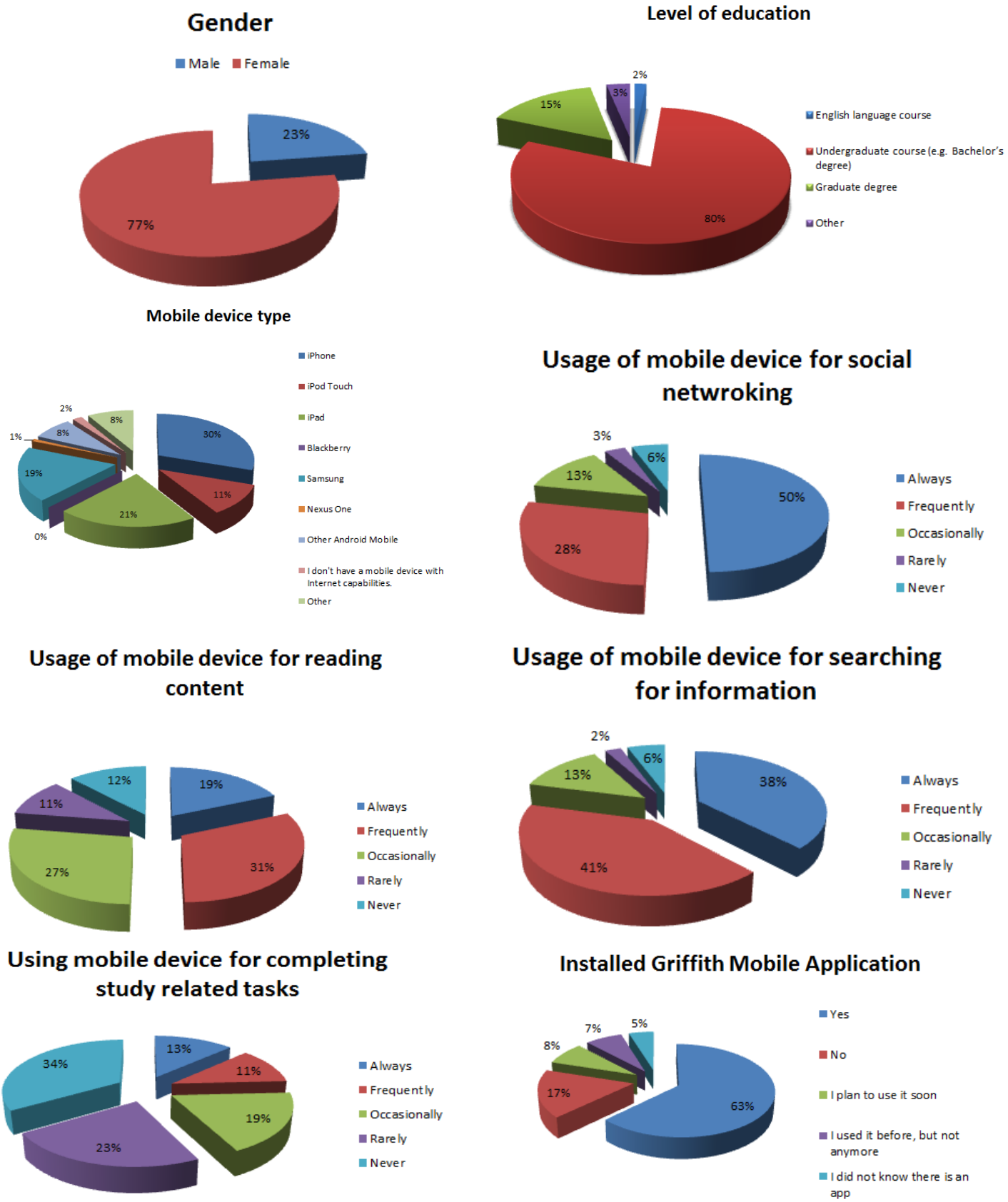

Fig.6. Respondants demographics

c) H6: Students' satisfaction would positively affect students' intention to use mobile Learning-systems.

The correlation analysis result in Table IX below shows that there is a fairly strong positive and significant relationship between SS and BIU, r(124) =.686, p < .005. This correlation indicates that students' satisfaction about mobile-learning systems will increase students' behavioural intention to use mobile-learning systems. Hence, H6 is supported.

TABLE.X. SS AND BIU CORRELATIONS

Correlations		
Factors		BIU
SS	r-value	.686**
	p-value	.000
	N	124

SS: System Satisfaction; BIU: Behavioural intention to use

d) H7: Information quality would positively affect information satisfaction of mobile Learning-systems.

The correlation analysis result in Table X below shows that there is a fairly strong positive and significant relationship between IQ and IS, r(124) =.847, p < .005. This correlation suggests that when information quality increases, information satisfaction of mobile-learning systems will increase. Hence, H7 is supported.

TABLE.XI. IQ AND IS CORRELATIONS

Correlations		
Factors		IS
IQ	r-value	.847**
	p-value	.000
	N	124

IQ: Information Quality; IS: Information Satisfaction

e) H8: System quality would positively affect system satisfaction of mobile Learning-systems.

The correlation analysis result in Table XI below shows that there is a strong positive and significant relationship between SQ and SS, r(124) =.835, p < .005. This correlation suggests that when system quality increases, students' satisfaction of mobile-learning systems will increase. Hence, H8 is supported.

TABLE.XII. SQ AND SS CORRELATIONS

Correlations		
Factors		SS
SQ	r-value	.835**
	p-value	.000
	N	124

SQ: System Quality; SS: System Satisfaction

f)H9: Information satisfaction would positively affect performance expectancy.

The correlation analysis result in Table XII below shows that there is a strong positive and significant relationship between IS and PE, r(124) =.745, p < .005. This correlation suggests that when information satisfaction increases, students' performance expectancy will increase. Hence, H9 is supported.

TABLE.XIII. IS AND PE CORRELATIONS

Correlations		
Factors		PE
IS	r-value	.745**
	p-value	.000
	N	124

IS: Information Satisfaction; PE: Performance expectancy

g) H10: System satisfaction would positively affect effort expectancy.

The correlation analysis result in Table XIII shows that there is a strong positive and significant relationship between SS and EF, r(124) =.745, p < .005. This correlation suggests that when system satisfaction increases, students' effort expectancy will increase. Hence, H10 is supported.

TABLE.XIV. SS AND EF CORRELATIONS

Correlations		
Factors		EF
SS	r-value	.708**
	p-value	.000
	N	124

SS: System Satisfaction; EF: Effort expectancy

4) The relationship between lecturer attitude constructs and behavioural intention

a) H11: Lecturers' attitude toward using mobile devices would positively or negatively affect students' behavioural intention to use mobile Learning-systems.

The correlation analysis result in Table XIV below shows that there is a fairly a weak positive relationship between LT and BIU, r(124) =.312, p < .005. Since the correlation is significant, H11 is statistically supported.

TABLE.XV. LT AND BIU CORRELATIONS

Correlations		
Factors		BIU
LT	r-value	.323**
	p-value	.000
	N	124

LT: Lecturer attitude; BIU: Behavioural intention to use

The table below summarise the hypothesis after the testing was done.

TABLE.XVI. HYPOTHESIS SUMMARY

No.	Statement	Result
H1	Performance expectancy would positively affect students' behaviour intention to use mobile Learning-systems	Supported
H2	Effort expectancy would positively affect students' behaviour intention to use mobile Learning-systems	Supported
H3	Social influence would positively affect students' behaviour intention to use mobile Learning-systems	Supported

H4	System quality would positively affect students' satisfaction about mobile Learning-systems	Supported
H5	Information quality would positively affect students' satisfaction about mobile Learning-systems	Supported
H6	Students' satisfaction would positively affect students' intention to use mobile Learning-systems	Supported
H7	Information quality would positively affect information satisfaction of mobile Learning-systems	Supported
H8	System quality would positively affect system satisfaction of mobile Learning-systems	Supported
H9	Information satisfaction would positively affect performance expectancy	Supported
H10	System satisfaction would positively affect effort expectancy	Supported
H11	Lecturers' attitude toward using mobile devices would positively affect students' behavioral intention to use mobile Learning-systems	Supported

VI. Discussion

The current study combines well-known theories that have been used in similar researches. Research model employ constructs found in UTAUT, IS Success, Modified IS Success, and other relevant literature.

In general, the statistical analysis shows that the findings of the current study are consistent with the original theories findings[5, 7, 40, 44-46]. All constructs within this study were proven to have positive correlations that are statistically significant. Overall, the analysis shows that students behavioural intention to use a mobile learning system is greatly affected by their effort expectancy and performance eexpectancy, information and system satisfaction, information and system quality. Additionally, with less effectiveness, lecturer attitude and social influences are less likely to influence one's behavioural intention. The findings suggest that all previously mentioned variables can positively influence students' behavioural intention to use mobile-learning systems. Noticeably, the relationship between performance expectancy and behavioural intention to use is stronger than the relationship between effort expectancy and behavioural intention. It is also noteworthy to mention that a large percentage of respondents were female. Hence further investigation on the gender effect would lead to further findings.

In Summary, the statistical analysis proves the ability of the proposed research model to measure the behavioural intention of students to use mobile-learning systems. Additionally, revision and further testing is required to validate the effect of lecturers' attitudes on students' behavioural intention.

VII. Conclusion

This study 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. The research model was validated using a questioner distributed to university students via online survey. The necessary steps were undertaking to ensure content validity and reliability of the research instruments. The data were collected and analysis using SPSS to investigate the relationships proposed in the research hypotheses. The overall results confirms the findings found in similar literature, and shows a strong and positive correlations between the various study constructs and students' behavioural intention to use mobile-learning systems. Overall, students tend to develop a positive behavioural intention to use mobile-learning systems. Students believe that behavioural intention to use mobile-learning systems is greatly affected by the perception of its ease of use and usefulness. Additionally, Information and system quality are also important factors that improve students' behavioural intention by increasing students' satisfaction about information and system quality. In contrast, the results show that social influence and lecturers' attitude toward using mobile devices during lectures are less likely to hinder students from developing a positive behavioural intention.

The research findings are valuable for paving the future of assessing students' behavioural intention to use mobile-learning systems. However, the limitation of the current study should be noted. The following subsection describes some of the limitations and provides suggestions for future improvements.

A. Research limitations and future work

There are various limitations to this study. First, is the limited ability to generalise the findings. Online survey was employed in this study, and online surveys are not free of limitations[59]. The lack of personal contact with respondent may affect the response rate in web-based surveys more than in other type of surveys[60]. In addition, a higher sample size would lead to make the conclusion more general.

Further research may investigate the role of other variables, including users' characteristics, and adding more variables to the original constructs found in the models used for this research. A systematic research may also extend this exploratory study.

In addition, several other statistical tests including factor analysis, multiple regressions, and structural equation modelling, etc. could be conducted to confirm variables' validity. Those approaches were beyond the current study scope; however it remains an area of interest for a future research.

Finally, the research model is subject to further modification. The preliminary analysis shows that further validation and investigation may reveal other factors in the context of mobile-learning systems.

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Appendices

A. Research instruments

Mobile Learning-system usage: An integrated framework to measure students' behavioural intention ***Scales and items***						
Demographic Information						
1. **Section I**		**Demographic Characteristics Information**				
Q	**Variable**	**Value**				
SUR	Are you taking this survey on a mobile device?	SUR1: ☐ Yes SUR2: ☐ No				
AGE	In which category is your age?	AGE1: ☐18-24 years AGE2: ☐25-34 years AGE3: ☐35-44 years AGE4: ☐other, please specify:_____				
GEN	Please specify your gender	GEN1: ☐Male GEN2: ☐Female				
EDU	Level of education(Current course)	EDU1: ☐English language course EDU2: ☐Undergraduate course (e.g. Bachelor's degree) EDU3: ☐Graduate degree(Please specify:_____) EDU4: ☐Other, please specify:_____				
OWN	Please indicate the electronic equipment you currently own or plan to buy in the next three months. (Select all that apply)	OWN1: ☐ Netbook OWN2: ☐ Desktop OWN3: ☐ Laptop OWN4: ☐ Mobile phone (NOT Internet-capable) OWN5: ☐ Internet-enabled mobile device (e.g., smartphone, tablet, etc.) OWN6: ☐ Dedicated e-book device (e.g., Kindle, Nook, Sony Reader, etc.) OWN7: ☐ MP3 Player OWN8: ☐ Other ,please specify:_____				
DTPE	Which of the following Internet-enabled mobile devices do you currently use? (Select all that apply.)	DTPE1: ☐ iPhone DTPE2: ☐ iPod Touch DTPE3: ☐ iPad DTPE4: ☐ Blackberry DTPE5: ☐ Samsung DTPE6: ☐ Other Android Mobile (Please specify) DTPE7: ☐ Nexus One DTPE8: ☐ I don't have a mobile device with Internet capabilities. DTPE9: ☐ Other ,please specify:_____				
ACC	What library/academic information or resources have you tried to access using your mobile device? (Select all that apply).	ACC1: ☐ View library hours ACC2: ☐ Ask a question ACC3: ☐ Using the directory to view contact information ACC4: ☐ Search library catalogue / databases ACC5: ☐ Request an item through interlibrary loan ACC6: ☐ Find out about labs ACC7: ☐ View campus news ACC8: ☐ View locations on the map ACC9: ☐ View your timetable ACC10: ☐ Renew library items ACC11: ☐ None of these ACC12: ☐ Other, please specify:_____				
USE	***To what degree do you use your Internet-enabled mobile device for the following activities?***	*Always*	*Frequently*	*Occasionally*	*Rarely*	*Never*
USE1	Social networking	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE2	Reading content (e.g., e-books, articles, etc.)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE3	Getting news alerts	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

USE4	Accessing email	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE5	Text messaging	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE6	Searching for information	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE7	Getting directions	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE8	Uploading content	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE9	Playing games	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
USE10	Listening to music or watching videos	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

Continued: Mobile Learning-system usage: An integrated framework to measure students' behavioural intention
Scales and items

USE11	Completing coursework or participating in lectures	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
GAPP	Have you used Griffith University Application for mobile devices?	GAPP1: ☐ Yes GAPP2: ☐ No GAPP3: ☐ I plan to use it soon GAPP4: ☐ I used it before, but not anymore GAPP5: ☐ I did not know there is an app				

UTAUT(adapted from Venkatesh, Morris, Davis, & Davis (2003))

2. **Section II** — **Performance Expectancy**

		Strongly Disagree			*Neutral*			*Strongly Agree*
PEE1	I feel that mobile learning is useful.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
PEE2	Mobile learning improves my study efficiency.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
PEE3	Mobile learning improves my study convenience.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
PEE4	Mobile learning lets me do study related tasks more quickly.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

3. **Section III** — **Effort Expectancy**

		Strongly Disagree			*Neutral*			*Strongly Agree*
EFE1	Skilfully using mobile learning is easy for me.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
EFE2	I find that using mobile learning is easy.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
EFE3	Learning how to use mobile learning is easy for me.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
EFE4	My interaction with mobile learning is clear and understandable.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

4. **Section IV** — **Social Influence**

		Strongly Disagree			*Neutral*			*Strongly Agree*
SOI1	Those people that influence my behaviour think that I should use mobile learning	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SOI2	Those people that are important to me think that I should use mobile learning	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

5. **Section X** — **Behavioural Intention to Use**

	Strongly Disagree	*Neutral*	*Strongly Agree*

BI1	I intend to use the mobile learning system in the future	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
BI2	I predict I would use the mobile learning system in the future	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
BI3	I plan to use the mobile learning system in the future	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

IS Success (adapted from DeLone & McLean (1992,2003))

6. **Section V** — **Information Quality**

		Strongly Disagree			*Neutral*			*Strongly Agree*
IQ1	The mobile learning system provides information that is exactly what you need (Content Accuracy)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ2	The mobile learning system provides information you need at the right time (Availability)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ3	The mobile learning system provides information that is relevant to your course (Usability, relevance)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ4	The mobile learning system provides sufficient information for your purposes (Quantity of information)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ5	The mobile learning system provides information that is easy to understand (Understandability)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ6	The mobile learning system provides up-to-date information (Currency)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ7	The mobile learning system provides information that appears readable, clear and well formatted (User interface)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ8	The mobile learning system provides required information on time. (Timeliness)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IQ9	The mobile learning system provides information that is suitably concise.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

Continued: Mobile Learning-system usage: An integrated framework to measure students' behavioural intention
Scales and items

7. **Section VI** — **System Quality**

		Strongly Disagree			*Neutral*			*Strongly Agree*
SQ1	The mobile learning system allows a high level of customization for different courses	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ2	The mobile learning system provides for personalized information presentation	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ3	The mobile learning system is easy to use	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ4	The mobile learning system is user-friendly (Easy to learn)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ5	The mobile learning system provides a high of availability (Access)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ6	The mobile learning system provides an appropriate level of on-line assistance and explanation (User requirements)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ7	The mobile learning system provides interactive features for an effective user experience	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ8	The mobile learning system provides satisfactory support to users of the system (Help and training)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ9	The mobile learning system has features that support the needs of a range of different courses (Flexibility)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ10	The mobile learning system has a high level of reliability	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SQ11	The mobile learning system provides high-speed information access (Efficiency)	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

Modified IS Success(Adapted from Seddon and Kiew(2007))

8. **Section VII**		**User Satisfaction**						
		Strongly Disagree			*Neutral*			*Strongly Agree*
US1	Mobile learning systems is effective	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
US2	Mobile learning systems is efficient	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
US3	Overall, I am satisfied with mobile learning systems	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

9. **Section VIII**		**Information Satisfaction**						
		Strongly Disagree			*Neutral*			*Strongly Agree*
IS1	Overall, the information I get from mobile learning system is very satisfying	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
IS2	I am very satisfied with the information I receive from mobile learning system	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

10. **Section IX**		**System Satisfaction**						
		Strongly Disagree			*Neutral*			*Strongly Agree*
SS1	All things considered, I am very satisfied with mobile learning system	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
SS2	Overall, my interaction with mobile learning system is very satisfying	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐

Lecturers' attitude (New scale)

11. **Section X**		**Lecturers' attitude**						
		Strongly Disagree			*Neutral*			*Strongly Agree*
LT1	I can use my mobile device in a formal learning environment e.g. searching resources in lectures	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
LT2	Lectures encourage me to use mobile devices device in a formal learning environment e.g. searching resources in lectures	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐
LT3	Lecturers say that mobile devices sometimes can be very distracting.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐