

# A Preliminary Study of Students' Attitude on m-Learning: An Application of Technology Acceptance Model

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**Abstract**—Seventy-five students had been selected randomly from an institution of higher learning to predict their behavioral intentions towards using the m-learning. The study uses standard instrument to capture students' responses on the three basic constructs of technology acceptance model (TAM) that includes perceived usefulness (PU), perceived ease of use (PEOU) and attitude. Then data were analyzed through Smart-PLS in order to find out if PU remains the significant determinant of the attitude that in turn predicts the behavioral intention of using the m-learning technology. This model has moderate explanatory power with 38% of the variance in behavioral intention is from the attitude of the students. Based upon the conclusion, some pedagogical recommendations have been made for the relevant authorities.

**Index Terms**—M-learning, technology acceptance model (TAM) students, technical university and Brunei Darussalam.

## I. INTRODUCTION

The ubiquitous computing has now entered into the next generation from “e” (electronic) to “m” (mobile) world. This revolution in the telecommunications started with the advent of 3G of mobile telephone, then on 4G technologies that have resulted in reshaping the use of mobile phones, from making calls and sending and receiving short message (SMS) and multimedia message (MMS) to more versatile and multi-tasking instruments. Thus leads the users towards knowledge driven society. In education sector (teaching/learning) of e-learning applications and developments, the mobile phones users started enjoying the benefits through m-learning. M-learning is considered as the next generation of e-learning using mobile technologies as to facilitate educations towards teaching and learning purposes anywhere and anytime [1]. The increase of mobile phone subscribers especially in the developing world is due to the varieties of the mobile services offered by the service providers at a lower cost so the dependency of the mobile phone users have also increased. According to the latest statistics, Brunei is reported as the country with highest percent of mobile phone penetration of 115% with no of subscribers (449, 260) exceeding the country population of 400,000 in 2013. More than 90% of the Internet subscribers have high speed broadband access with around half of these are on a mobile broadband platform ([www.itu.int/ITU-D/ict/newslog/Categoryview.category,mobile%21](http://www.itu.int/ITU-D/ict/newslog/Categoryview.category,mobile%21)).

With the broader users' base the use of the mobile phones has also been spread to the academic institutions. Mobile technology offers a new venue of learning for people of all ages, from anywhere and at anytime with tremendous benefits of flexibility, low cost, eases of use, learning support and reliable learning situations.

### A. Mobile-Learning in Higher Education

Mobile devices are found to be much more affordable than desktop computers and therefore represent a less expensive access to the Internet (even if the cost of connection is higher) [2]. The advent of tablets (ipads) can now access mobile internet with much more functionality than desktop computers. Increasing use of mobile devices in education enhanced by having advances in mobile technology was studied [3] and [4]. Ref. [5] reported of a research that stated nine different activities students perform in higher education setting using their mobiles [6] such as 1) send pictures or movies to colleagues, 2) uses of mobile phone as MP3 player, 3) access information or services on the Web, 4) make video calls, 5) take digital photos or movies, 6) send or receive emails, 7) use mobile phones as a personal organizer (e.g. dairy, address book), 8) send and receive SMS to colleagues, 9) call the colleagues and others. M-learning therefore provides an opportunity for the new generation with better communications and activities without taking into account the places or time. However, the benefits gain from mobile services depend on the intentions of the students to use them such as for education purpose [7].

So the question of using the technological innovations lies in the perception of the users. Therefore, with this research, we then look into the theoretical background or foundations. The acceptance of mobile learning by students is critical to the successful implementation of mobile learning system. Thus it is important to understand the factors that contribute toward students' intentions to use m-learning. There are many models that have been developed to investigate and understand the factors affecting the acceptance of computer technology in the organizations. Among those are the Theory of Reasoned Action (TRA) [8]; the Theory of Planned Behaviour (TPB) [9], Technology Acceptance Model (TAM) [10] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [11] and Diffusion of Innovations (DOI) [12]. However, it has been noticed that the most used model by Information Systems (IS) academics and practitioners is the TAM. TAM is an adaptation of the TRA to the field of IS.

Researchers across the globe have studied these theories for various technological innovations such as for e-learning context [13], [14], [15], for online shopping [16] and for Web-based information systems [17].

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From an academic perspective, studies have been conducted in Brunei Darussalam using TAM to determine the Internet use among students [18], senior executives [19] and business managers [20]. Studies were also undertaken on e-learning adoption among students and academic staff of an institution of higher learning focusing on TRA [21], [22]. One study was conducted to assess the perception of mobile phones use and its implications for teenagers in Brunei Darussalam [23]. The study result indicated that perception of mobile phone among teenagers was viewed as necessities and a tool of emancipation from parental control and surveillance and further used to access social networking sites and Facebook.

The m-learning is relatively new in Brunei especially among students of technical university, as no prior study had been undertaken within the context of technical university students' intention to use the m-learning. This paper therefore tries to fill-in the gap in the literature by validating the current TAM, by studying the Bruneian technical university students behavioral intentions to use smart phones for educational purpose. Therefore, this paper sought to answer two basic questions with the following objectives:

- 1) To study the key factors that motivates students' intention to use m-learning.
- 2) To find the robustness and parsimony of the technology acceptance model (TAM) in the context of new technological innovation like m-learning in Brunei Darussalam.

## II. REVIEW OF RELEVANT LITERATURE & DEVELOPMENT OF HYPOTHESES

This section begins with an examination of the theoretical framework used in this research. Then related literature and a few studies in mobile learning are used to identify as what factors might influence the adoption of mobile learning.

### A. Technology Acceptance Model (TAM) and m-Learning

TAM developed by [10] is an adaptation of the Theory of Reasoned Action (TRA) [8]. TAM, UTAUT and other adoption theories are heavily influenced by Theory of Reasoned Action in order to explain the individual adoption behavior from a social psychological perspective. Although TRA is widely accepted and fundamental in human behavior research. However, TAM is considered to be more specific to information systems (IS) than TRA; as it proposes a theoretical model to predict the acceptability of a technology and to identify modifications needed in order to make the system acceptable to the users. TAM is considered as one of the most parsimonious, robust and notable technology acceptance theoretical model. [24] further suggests that TAM is now one of the keys and most applied theoretical model in the field of IS.

The two fundamental constructs identified by TAM for determining an individual intention to use technology are 'perceived usefulness (PU)' and 'perceived ease of use (PEOU)'. [10] defined PU as "the degree to which a person believes that using a particular system would enhance his/her job performance". PEOU is the "degree to which a person believes that using a particular system would be free of

efforts" [25]. TAM theorizes that an individual's behavioral intention determines a system which the person uses, behavioral intention is jointly determined by PU and individuals' attitudes toward using the system. The attitude/behavioral intention relationship TAM suggests that all else being equal, people form intention to perform behavior towards which they have positive effect [25].

The key strength of TAM is that empirical studies support it and consistently explains an approximately 40% of the variance in usage intention and behavior of individuals in organizational setting. [26] suggests that TAM is IT specific and it can further address diverse users population, technology settings and organizations. Finally, the psychometric measurements have been validated. The major weakness is that TAM does not cover social and cultural factors [27]. For these very reasons, TAM has been selected for this study. There are numbers of studies with the context of m-learning that are supported by TAM, extended TAM and UTAUT frameworks [5], [7], [28]-[32].

Fig. 1 below provides the justification of using the constructs and postulates the hypotheses.

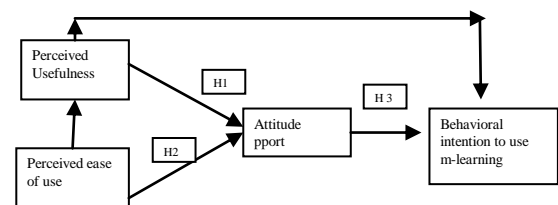


Fig 1. Technology acceptance model.

### B. The Perceived Usefulness

Within the context of m-learning, perceived usefulness has been proven to be a significant factor especially in the delivery of contact awareness support and providing appropriate information to support a student's university life, at the right time and at the right place. This has made the useful context as prime factor [33]. In addition, use of mobile devices as an interactive tool in education has proven useful for increasing the communication between learners and learners, or with instructors [34]. Similarly, [35] found the significance of perceived usefulness in the context of m-learning among university students in New Zealand. Thus it is hypothesized:

*H1: Perceived usefulness is positively associated with the behavioral intentions to use m-learning.*

### C. The Perceived Ease of Use

[36] found ease of use to be one of the five significant factors that determined general use of wireless handheld devices. An individual might have a higher intention to adopt mobile learning if they think mobile learning is easy to operate. Again [35] found a support in their m-learning study in New Zealand. Thus on that basis, we propose our second hypotheses:

*H2: Perceived ease of use is positively associated with the behavioral intentions to use m-learning.*

### D. The Attitude

Attitude is an individual's positive or negative feelings about performing the target behavior [10], [37] and others

have demonstrated attitude towards using a technology is a significant determinant of behavioral intentions. [37] also found that users were more likely to use new innovation if they had strong feelings with those innovation. Another study found that young students enjoyed using a mobile learning applications [38]. Similarly, [35] have found a strong support in their m-learning study in New Zealand. Thus it is hypothesized:

*H3: Attitude is positively associated with the behavioral intentions to use m-learning.*

### III. METHODOLOGY

#### A. The Design of the Instrument

To fulfill the research objectives, the questionnaire for this survey had been modified and edited after reviewing the literature and on the basis of the model developed. The questionnaire was pre-and post tested to assess the reliability and validity. On the basis of face and content validity, it was revised and refined before administrating the survey. The multidimensional instrument was developed in three parts in order to capture the information. Part 1 contained demographic and organizational data, consisting of questions pertaining to data with nominal and ordinal measurements. Part 2 captured the information on the three exogenous constructs as well as the one endogenous construct (behavioral intention) on 5-point Likert scale (1-strongly disagrees to 5 for strongly agree). This was measured with a seventeen items questionnaire. The source of instrument was adapted and modified to cater the m-learning. Part 3 provides details of the sources of constructs and the number of items used in this study.

#### B. The Data Collection

In literature, several quantitative research methodologies exist (e.g. survey, experimental, quasi-experimental) survey are frequently used to test a theoretical underpinning [39] and especially when respondents are asked to provide information about themselves. For example, about their attitude, belief, demographics or past behavior [40]. So keeping in view of the nature and objectives, the survey approach was used. Students from one faculty in Business & Computing of the technical university were selected and a random sampling of around 150 students were used in early May 2014. Techniques sample size for this survey was similar as suggested by [41] i.e., not be less than 100. Students were approached in various laboratory sessions by the team of researchers personally for this purpose. The sampling frame included all the students who own 3Gs mobile phones, tablets or PDAs.

#### C. The Sample

One hundred and fifty questionnaires were distributed to students in Business and Computing faculty. Out of them, 80 questionnaires were received. After closer examination, seventy-five were retained for the study. The five were dropped because of non filling of responses for all the constructs. This made the response rate to 50% that would consider sufficient to draw logical conclusion. However, it was in line with the minimum recommended rate of 30% for survey research [42]. The basic statistics and reliability

coefficient are provided in Table 3.

*Response bias* is a type of cognitive bias which can affect the results of statistical survey especially in the case when respondents answered the questions in the way not reflecting their true beliefs. This may happen when the respondents wished to please the questioner by answering what: appears to be the “morally right” answer. This occurs often in the wording of the questionnaire [43]. This was dealt by improving the face validity of the questionnaire by having an expert opinion on all the items of questionnaire and by physically examining the questionnaire by our survey team at the time of data collection.

### IV. RESULTS

Data obtained from the survey were analyzed by using descriptive statistics features of SPSS-18. The model was tested by using Smart-PLS.

#### A. Background Profile

The background data of participating students has been summarized in Table I. The Table I describes the characteristics of respondents. Majority are males within age group of 17-25 years (55%).

TABLE I: DEMOGRAPHICAL DATA

Variable	Description	Percentage
Gender	Male	59%
	Female	41%
Age	Below 17	4%
	Between 17-25	55%
	Above 25	41%
Types of mobile phones	4Gs	6%
	3Gs	82%
	I-pad/tablets	12%
Using the Internet at	At home	43%
	At University	15%
	Mobile Internet	42%
Types of service provider	DST	50%
	B-mobile	27%
	Telbru	23%
Level of familiarization in using mobile services	Average	71%
	Above average	28%

#### B. Validity and Reliability

In order to assess the validity and reliability, tests were performed in this study. To get the reliability of the questionnaire, the coefficient of Cronbach's alpha [44] was taken into account. Minimum Cronbach's alpha values are greater than 0.70, in order to indicate reliability of the instrument [45]. During the initial screening of conducting reliability tests, some items were dropped because of low corrected-item total correlation which was less than 0.40, i.e., the cut-off value suggested [46]. The remaining items were applied the factor analysis which was subjected to principal component analysis using varimax rotation, as in Kaiser-Normalization as the techniques of rotation to examine both the individual items and the relationship among them [46]. All the items that were loaded with more than one factor at the cut-off value of 0.40 were eliminated from the constructs. The result of the factor analysis is not attached to avoid unnecessarily lengthy paper. In addition, two types of validity were assessed to validate: convergent and

discriminant validities. [47] had suggested that convergent and discriminant validities should be examined for construct validity. Therefore, convergent validity was assessed by examining composite reliability (CR) and average variance extracted (AVE) from the four constructs [46].

CR is calculated by squaring the sum of loadings, and then dividing it by the sum of squared loadings, plus the sum of the measurement error. In the AVE measures, the variance captured by the indicators relative is used to measure the error. Table III provides the quality control; statistics with internal consistency and CR values. The CR values for all four constructs were between the suggested minimum of 0.70 [46]. Table II shows the inter-constructs correlation and values

shown diagonally in order to represent the square root of variance. The average variance of 0.50 suggested is needed for further evidence for convergent validity [48]. These AVE values could also be used to assess discriminant validity which occurred when the AVE exceeded the square pair with the correlation between the construct [49].

TABLE II: SHOWING CORRELATION MATRIX

Constructs	1	2	3	4
Attitudes (1)	<b>.70</b>			
PU (2)	.69	<b>.72</b>		
PEOU (3)	.66	.70	<b>.71</b>	
Behavioral intention (4)	.60	.58	.52	<b>.86</b>

(Diagonal in bold represents average variance extracted)

TABLE III: RELIABILITY &amp; QUALITY CONTROL STATISTICS

	Mean	Std .dev	Cronbach Alpha( $\alpha$ )	Original items	AVE	CR	Source
Perceived usefulness	3.84	0.60	.83	6	.50	.84	Davis (1989)
Perceived ease of use	3.58	0.69	.84	5	.52	.84	Davis (1989)
Attitude	3.84	0.64	.79	4/5*	.51	.80	Taylor & Todd (1995)
Behavioral intentions	3.49	0.72	.80	2	.74	.85	Davis (1989)

\*One item was dropped because of lowest corrected-item total in reliability analysis

**Common Method Variance:** The data on all constructs in this study is self-reported and collected from respondents which are liable to this common method variance problem. It is because of this reason that the correlation or part of them does not occur to actual relationship between variables as they are measured by the same method [50]. A common method variance would tend to inflate the correlation between the variables [51]. To examine the common method variance, we conducted a Harman's single factor test [50] by using SPSS factor analysis. The result has indicated that largest variance explained by an individual factor is 45%. It may seem high but is still below 50% of the cut-out limit. Therefore, we believe that there is no significant problem with common method variance.

### C. Analysis of the Model with Smart-PLS (Path Analysis)

The relationship of the students' perceived usefulness and perceived ease of use with mediating attitude with the dependent variable behavioral intention was investigated using Smart-PLS; multiple regression analysis. Partial-least squares were used to test the hypothesized relationship among the variables in the model. PLS is a second generation multivariate technique that facilitates testing of the psychometric properties of the scales used to measure a variable, as well as an estimation of the parameters of the structural model i.e. the strength and direction of the relationship among the model variables [48], [52]. To test the estimated path coefficient, path loading and statistic were calculated. PLS allows the researcher to test the relationship between the measures simultaneously [53]. Further test includes the estimation of the reliability coefficient, CR of the measures as well as an examination of convergent and discriminant validity of the research instrument. Re-sampling procedure such as bootstrapping which produces t-statistic was used to assess the structural paths [54]. In addition, model's predictive power was assessed by measured  $R^2$  value for the endogenous variables [48]. The model was evaluated

and shown in Fig. 2. As a result, perceived usefulness has a significant path to the attitude as compared to non-significant path from ease of use to the attitude. The explanatory power of attitude- mediating variable shows that 54% of the variance is shared by the PU, whereas, 38% of the total variance towards behavioral intention is explained by the attitudes that shows the moderate parsimony of the model. Similarly, path between PEOU to PU is also significant.

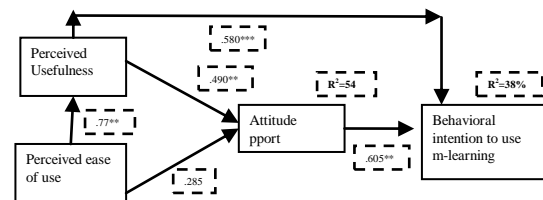


Fig. 2. Showing path coefficients (\*\* shows significant  $p < 0.01$ ).

## V. DISCUSSION

This pioneering study results suggested that TAM factors of PU and PEOU that had been validated through numerous studies were also determined to be significant determinants of mobile learning acceptance. The study revealed that TAM construct PU was the most significant predictors of behavioral intention with significant path coefficient (.58) and thus acceptance. PU was significant predictor of use intention, whereas, the students' perception of usefulness has been derived from having positive feeling of ease of use. However, the main reason of less importance of PEOU was due to the reason that mobile phones especially the 3Gs or smart phones had become accessible for everyone and that was why perceived EOU component did not have an impact on intentions. In contrast to previous studies [55], [56], perceived ease of use had no significant effect on m-learning attitude. This was also noticed through the mean value provided in Table III which indicates the mean value of PEOU (3.58) is much lower than mean value (3.84) of PU and to some extent a general feeling that m-learning is not easy to

use. This is contrary to popular belief in m-learning literature that showed technological restrictions seemed not to induce significant usability problems inhibiting m-learning adoption [7]. Our result had supported [7] who concluded that PU had the highest path coefficient and remained strong predictors of behavioral intention and attitude to use.

These results validate the power of TAM constructs and its appropriateness in predicting acceptance of mobile learning. The relationship between PEOU and PU also confirmed [10] as well as the other relationship with TAM had also been confirmed. In addition, this model explains the significant portion of the variance in students' intention to use m-learning. 38% of the shared variance is in line with the original TAM model of 40% as well as the three studies that were conducted on TAM in Brunei Darussalam and were mentioned in section 2. Results also support [37] who stated that 42% of the variance was explained in intention to use.

## VI. CONCLUSION

The study has achieved its objectives. This preliminary study on students' use of the m-learning is really necessary because the m-learning in higher education institution is still at early stage. The results indicate that two of the three constructs of the original TAM are strong predictors of students' intentions on m-learning. We, therefore, could use the results of the study to support research on developing m-learning technology for students in future.

In addition, the fact that more than half (71%) of the students have average familiarization level with the mobile. They have good perception with the m-learning as well as positive attitude and usefulness components of TAM. The result has showed that these two aspects had high level of acceptance. The survey results confirmed that two of the three hypotheses led to the behavioral intention to use m-learning. Therefore, in future the university administration should focus on the design of m-learning system that is appropriate with the students' perception. PEOU remained insignificant determinant of attitude, yet 80% of the students have their concern about the ease of use component. So any effort from the university administration in line with this research finding coupled with good perception and dynamic university's policy will lead to the success of m-learning system in the universities.

**Limitations:** As in most researches using survey methodology, this study has its own weaknesses. Several limitations of this study qualify the findings and suggest direction for future research. The study is limited to its small sample size and its model. By readdressing and expanding the study with extended TAM, TAM 2 and/or UTAUT, will bring further insight that will definitely help to improve the study.

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