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The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana

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ABSTRACT

In this paper, we compare the utility of modified versions of the unified theory of acceptance and use of technology (UTAUT) model in explaining mobile learning adoption in higher education in a developing country and evaluate the size and direction of the impacts of the UTAUT factors on behavioural intention to adopt mobile learning in higher education. The data were obtained through a web survey of university students and the models are estimated in a structural equations modelling framework. Many of the UTAUT relationships are confirmed, but some are contradicted. The results suggest that culture and country level differences moderate the UTAUT effects, hence, a straightforward application of the model regardless of the context can lead to non-detection of important relationships and to suboptimal mobile learning promotion strategies. Including attitude in the model is also a prudent modification since it increases its explanatory power.

Keywords: *mobile learning, UTAUT, higher education, technology adoption, Guyana*

INTRODUCTION

Mobile learning (MLearning) which emerged with the evolution of mobile devices, has extended the reach of e-learning and distance education systems by allowing educators and students to teach and learn anywhere, anytime and on the move (Negas & Ramos 2011; Wang et al. 2009). Mobile devices include, but are not limited to, smart phones, mp3 players, tablet PCs and PDA's. The ubiquity of these devices along with their popularity among students make them suitable for use in educational contexts (El-Hussein & Cronje 2010; Negas & Ramos 2011; Jeng, et al. 2010). Although the rapid increase in the quantity of mobile devices has enabled institutions to begin exploring their use (Wang et al., 2009), MLearning in higher education is still an emerging field (Cheon, Lee, Crooks, & Song 2012). The slow pace of adoption by educational institutions may be due to several reasons. For example, the cost of hardware and software systems to support MLearning can be high. In addition, educators need to be trained in using these new systems to teach, communicate with students and evaluate their learning progress. Furthermore, the cost of mobile Internet access may also result in low adoption rates. Overall, MLearning presents many opportunities for innovation, but its challenges are not fully understood (Wagner 2005).

MLearning has not been formally integrated into the delivery of higher education in Guyana. This is also true for e-learning in general, but e-learning technologies are being used by students and teachers (Gaffar, Singh & Thomas 2011). Similarly, there is the potential for mobile devices to be integrated into higher education in this context. However, in addition to the infrastructure and other physical requirements, the success of MLearning will depend on human factors including skills, attitudes and culture (Kukulska-Hulme & Traxler 2007). Studies of MLearning adoption in Guyana are therefore important since they will help to identify the important drivers of adoption.

Several MLearning studies are found in the literature. These studies are often based on the theory of reasoned action (Fishbein & Ajzen 1975). While several models have been used in such studies, the unified theory of acceptance and use of technology (UTAUT) (Venkatesh, Morris, Davis, & Davis 2003) has become very popular. An important limitation of the literature, however,

is that MLearning and technology adoption studies in general are done most often in Western contexts (Schepers & Wetzels 2007; Traxler 2007). This creates a relative paucity of evidence about whether the model relationships hold elsewhere. Given that measurements and the relationships among measures can be moderated by culture and country variables (Van de Vijver & Leung 1997), straightforward application of the UTAUT model in non-Western contexts may lead to suboptimal results. Hence, before the UTAUT model is used in the Guyanese context, it is important to re-evaluate its factors and the relationships among them.

This paper evaluates the UTAUT model in Guyana – a non-Western country – in the domain of MLearning in higher education. It compares alternative versions of the model and identifies the version that is best for the Guyanese context. This approach provides education institutions and practitioners with a context-appropriate model that can be used to evaluate adoption of MLearning (and of other technologies) in Guyana and similar countries. Based on the results, we also identify the most important drivers of adoption and identify areas for further methodological research. As far as we are aware, this is the first assessment of the UTAUT model in relation to MLearning in the Guyanese context. Our findings are therefore unique and are also informative in relation to technology adoption in general.

THE UTAUT MODEL

The UTAUT model which aims to explain technology acceptance, is based on eight technology acceptance theories or models. In particular, the UTAUT draws on the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), the Motivational Model, the Theory of Planned Behaviour (TPB), the combined TAM and TPB, the model of Personal Computer Utilization, the Innovation Diffusion Theory and the Social Cognitive Theory (Venkatesh et al. 2003). At the core, the UTAUT model uses behavioural intention as a predictor of the technology use behaviour. The included predictors of behavioural intention are based on the components the eight technology adoption models reviewed. The basic form of the UTAUT model is shown in Fig. 1.

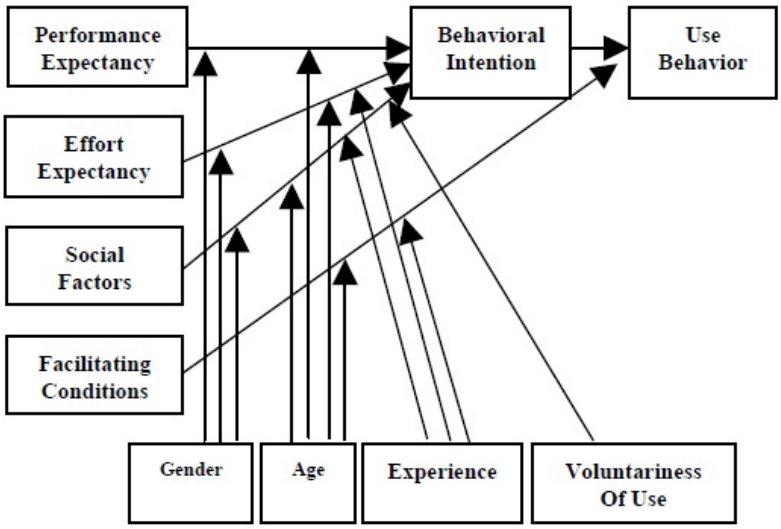

Fig. 1: The UTAUT Model (Venkatesh et al. 2003)

In addition to behavioural intention and use behaviour, the UTAUT model consists of four constructs:

- *Performance Expectancy:* The degree to which the individuals believe that the use of the technologies will results in performance gains. This may also be viewed as the perceived usefulness of the technologies.
- *Effort Expectancy:* The ease of use of the technologies.
- *Social Factors:* The extent to which the individuals believe that important others believe that they should use the technologies.
- *Facilitating Conditions:* The perceived extent to which the organisational and technical infrastructure required for the support of the technologies exist.

The model also includes four moderating variables: age, gender, education and voluntariness of use.

In the UTAUT model, performance expectancy, effort expectancy, and social factors have direct effects on behavioural intention, which along with facilitating conditions have direct effects on use behaviour. The effects of interactions of each of performance expectancy, effort expectancy and social factors with each of age and gender; interactions of experience with each of effort expectancy and social factors; and an interaction of voluntariness of use and social factors on behavioural intention are also included. Finally, there are effects of interactions of age and facilitating conditions and experience and facilitating conditions on use behaviour (Venkatesh et al. 2003).

Although, attitude which refers to the individuals' feelings (positive or negative) towards the use of the technologies (Fishbein & Ajzen 1975) is an important component of the TRA and the TAM, it is not explicitly included in the UTAUT model. According to Venkatesh et al. (2003), the effect of attitude on behavioural intention is spurious and it emerges only when performance expectancy and effort expectancy are omitted from the model. This means that attitude towards the use of the technologies does not provide enough unique information beyond that which is already provided jointly by performance expectancy and effort expectancy.

THE UTAUT RELATIONSHIPS

Venkatesh et al. (2003) indicates that the UTAUT model explains approximately 70% of the variance in behavioural intention. However, other researchers find lower explanatory powers; 64.5% (Wang & Shih 2009), 63.1% (Al-Gahtani, Hubona, & Wang 2007), 35.3% without interactions and 39.1% with interactions (Teo 2011). The reliability and validity of the model are also general confirmed (Al-Gahtani et al. 2007; Bandyopadhyay & Fraccastoro 2007; Habboush, Nassuora, & Hussein 2011; Nassuora 2012; Teo, 2011; van Raaij & Schepers 2008; Wang & Shih 2009), but consensus on the nature of the relationships among the factors is not always achieved.

Research results for the UTAUT relationships have shown many inconsistencies. Some find a positive effect of performance expectancy on behavioural intention (Al-Gahtani et al. 2007; Bandyopadhyay & Fraccastoro 2007; Im, Hong, & Kang 2011; Nassuora 2012; Wang & Shih 2009), but Jairak et al. (2009) find no such effect. There is more general agreement on a positive impact of effort expectancy (Bandyopadhyay & Fraccastoro 2007; Im et al. 2011; Jairak et al. 2009; Nassuora 2012; Wang & Shih 2009). In addition, whereas some report a positive effect of social factors (Bandyopadhyay & Fraccastoro 2007; Im et al. 2011; Jairak et al. 2009; Wang & Shih 2009), Nassuora (2012) finds no such effect. Venkatesh et al. (2003) also indicate that the

interaction terms are necessary for a significant effect of social factors to emerge. This is confirmed by Al-Gahtani et al. (2007), but contradicted by Jairak et al. (2009) who find a positive impact of social factors without including the interactions.

Some relationships that are hypothesised to not exist in the UTAUT model are also investigated by researchers and the findings are sometimes in conflict with the expectations based on the UTAUT model. The UTAUT model does not include an effect of facilitating conditions on behavioural intention since it is expected to be non-significant once both performance expectancy and effort expectancy are included (Venkatesh et al. 2003). Some studies confirm this (Al-Gahtani et al. 2007; Im et al. 2011; Nassuora, 2012; Wang & Shih 2009), but Jairak et al. (2009) report a positive effect of facilitating conditions. Researchers also investigate the influence of attitude towards the use of the technologies on behavioural intention. With both performance expectancy and effort expectancy included, Nassuora (2012) and Jairak et al. (2009) indicate that attitude impacts positively on behavioural intention. This latter result contradicts Venkatesh et al.'s (2003) indication that the effect of attitude is spurious.

With attitude included in the model, it is possible to study its relationships with the UTAUT factors. In this regard, researchers report that social factors impact positively on attitude (Jairak et al. 2009; Nassuora 2012). However, Jairak et al. (2009) find that performance expectancy and effort expectancy have positive effects on attitude whereas Nassuora (2012) finds no such effects. Finally, Nassuora (2012) reports a positive impact of facilitating conditions on attitude, but Jairak et al. (2009) find no such relationship.

The reported inconsistencies in the explanatory powers and the effects of the UTAUT variables may be due to variety in the data analysis techniques employed or to culture and country level differences. To illustrate these points, we compare three of the cited studies. Whereas Im, Hong, and Kang (2011) use structural equations modelling, Jairak et al. (2009) and Nassuora (2012) employ principal components analysis and principal axis factoring respectively. In addition, Im et al. (2011) use data from the United States and Korea while Jairak et al. (2009) and Nassuora (2012) use data from Thailand and Saudi Arabia respectively. Although there are differences in both the methods of analysis and the countries in which the studies are conducted, the effect of culture (or country) has important consequences. For example, using joint modelling of the UTAUT relationships and the effect of country, Im et al. (2011) confirm a moderating role of country. In addition, Al-Gahtani et al. (2007) relate the relative importance in the UTAUT relationships in Saudi Arabia to other contexts to known relative levels of cultural variables.

Culture can result in differences in the typical behaviours and attitudes associated with certain constructs resulting in alternative interpretations of the same items (Van de Vijver & Poortinga 1997; Van de Vijver & Tanzer 2004). It can also affect construct coverage by the proposed items, and stimulus familiarity (Van de Vijver & Leung 1997). Furthermore, culture can affect the relative importance of the relationships among the constructs (Im et al. 2011; Al-Gahtani et al. 2007). Consequently, both the measurements of the constructs and the relationships between the constructs measured by the items may differ from one culture (or country) to another. A relevant example is found in the study by Straub et al. (1997), which finds that the TAM model holds in the United States and Switzerland but not in Japan. It is therefore always important to re-evaluate even popular models whenever they are applied to a different country/cultural context: both the measurement of the constructs and the relationships among them should be re-evaluated. By evaluating the UTAUT measures and relationships in Guyana, this study determines whether or not the model is appropriate for this context.

HYPOTHESES

This study is conducted at the University of Guyana. In spite of the inconsistencies in the effects observed in the literature, we expect to find confirmation of the basic form of the UTAUT model. We advance the following hypotheses, which are consistent with the projections based on the UTAUT model.

Hypothesis 1: Performance expectancy is positively related to behavioural intention.
Hypothesis 2: Effort expectancy is positively related to behavioural intention.
Hypothesis 3: Social factors are positively related to behavioural intention.

One of the UTAUT hypotheses is that attitude towards the use of the technologies has no effect on behavioural intention once the effects of performance expectancy and effort expectancy are controlled. Consequently, attitude is not explicitly included in the UTAUT model. However, the studies that include attitude (Jairak et al. 2009; Nassuora 2012) find that it impacts positively on behavioural intention. These two studies are conducted in non-Western countries. We therefore believe that in such contexts, an explicit measure of attitude provides unique information beyond that provided jointly by performance expectancy and effort expectancy. We advance as the fourth hypothesis:

Hypothesis 4: Attitude towards the use of the technologies for learning is positively related to behavioural intention.

The inclusion of attitude enables investigation of its relationships with the UTAUT factors. Except for the agreement on a positive effect of social factors on attitude, the literature show inconsistencies in relation to the effects of the UTAUT factors on attitude, but whenever an effect on attitude is found, it is positive. In spite of the inconsistencies observed in the literature, we expect that the following hypotheses about effects on attitude to hold:

Hypothesis 5: Performance expectancy is positively related to attitude.
Hypothesis 6: Effort expectancy is positively related to attitude.
Hypothesis 7: Social factors are positively related to attitude.
Hypothesis 8: Facilitating conditions are positively related to attitude.

The UTAUT model also indicates that facilitating conditions has no effects on behavioural intention, but we believe that whenever there are constraints on resources, facilitating conditions will become an important predictor of behavioural intention. We therefore include as a final hypothesis:

Hypothesis 9: Facilitating conditions are positively related to behavioural intention.

DATA

The data for this study were collected by a web survey of the students of the University of Guyana between February and March, 2012. The questionnaire included a section on demographic information, a section on the use of various mobile devices and a third section on the UTAUT measurements. The instrument was tested with a group of 20 students before the final launching of the survey. These students were selected based on availability and willingness to participate. When the survey was launched, the invitations were sent by email to all registered students and they were asked to participate on a voluntary basis without any incentives. In total, 322 completed responses were obtained and this represents a response rate of approximately 5% of which 43.4%

are from males. This low response rate may be due to several reasons including unfamiliarity (first university-wide web survey at the institution). The distribution of the ages of the respondents is as follows: 16-20; 34%, 21-25; 35.4%, 26-30; 13.3%, and over 30: 17.3% and each faculty is represented in the data: Science (all sciences); 48.72%, Social Science; 37.42% and Education and Humanities; 13.86%.

The UTAUT factors along with attitude are measured by the items shown in Table 1. Each item is scored on a 5-point fully labelled rating scale with the agree/disagree format. These items are common in many MLearning studies (for example, Jairak et al. 2009), but it is often necessary for researchers to adapt the item wording to suit the context. For the current study, the items were modified to enhance comprehension by the respondents, based on feedback from the pilot exercise.

Table 1: *The UTAUT Items*

Construct	Item Code	Item
Performance Expectancy	PE1	Mobile Technologies are useful in education in general.
	PE2	Using mobile technologies enable students to accomplish tasks more quickly.
	PE3	Mobile technologies would improve students' performance.
	PE4	Mobile technologies would increase students' productivity.
Effort Expectancy	EE1	Mobile technologies are easy to use.
	EE2	Finding or using features in mobile technologies is easy.
	EE3	Learning to operate mobile technologies is easy.
Social Factors	SF1	People who influence my behaviour think that I should use mobile technologies.
	SF2	People who are important to me think that I should use mobile technologies for learning.
	SF3	University teachers are supportive of the use of mobile technologies.
Facilitating Conditions	FC1	In general, my University campus has support for mobile learning.
	FC2	In general, the country in which my university campus is located has support (infra-structure, policies etc.) for mobile learning.
	FC3	I have the resources necessary to use m-Learning.
	FC4	I have the knowledge necessary to use m-Learning.
	FC5	Support from an individual or service is available when problems are encountered with m-Learning technologies.
Attitude	ATT1	Using m-Learning technologies is a good idea.
	ATT2	I would like to use m-Learning technologies.
	ATT3	I believe that working with m-Learning technologies would be fun.
Behavioural Intention	BI1	I intend to use m-Learning technologies in the next semester.
	BI2	I predict I will use m-Learning technologies in my courses in the next semester.
	BI3	I have a plan to use m-Learning technologies in the near future.

Scale labels: 1 – Strongly disagree , 2 – Disagree, 3 – Neither Agree nor Disagree, 4 –Agree, 5 – Strongly Agree

METHOD

To analyse the data, we use structural equation modelling with latent variables in Mplus 7. Structural equation modelling is a combination of confirmatory factor analysis and path analysis. Confirmatory factor analysis allows specification of the construct-item relationships so that they can be tested against the theory whereas exploratory techniques such as principal components analysis and principal axis factoring do not allow the researcher to specify the paths. Confirmatory factor analysis and structural equation modelling are therefore determined to be better for testing the UTAUT theory than the exploratory techniques.

With large sample sizes, the Chi-square statistic becomes too sensitive; hence, we rely on alternative fit indices for overall model fit evaluation (Chen 2007). We use the Root Mean Squared Error (RMSEA) less than or equal to 0.06 and the Comparative Fit Index (CFI) greater than or equal to 0.95 to indicate that the model fits the data adequately (Hu & Bentler 1999). The Chi-square statistic is used to assist in the evaluation of nested models when modifications are required.

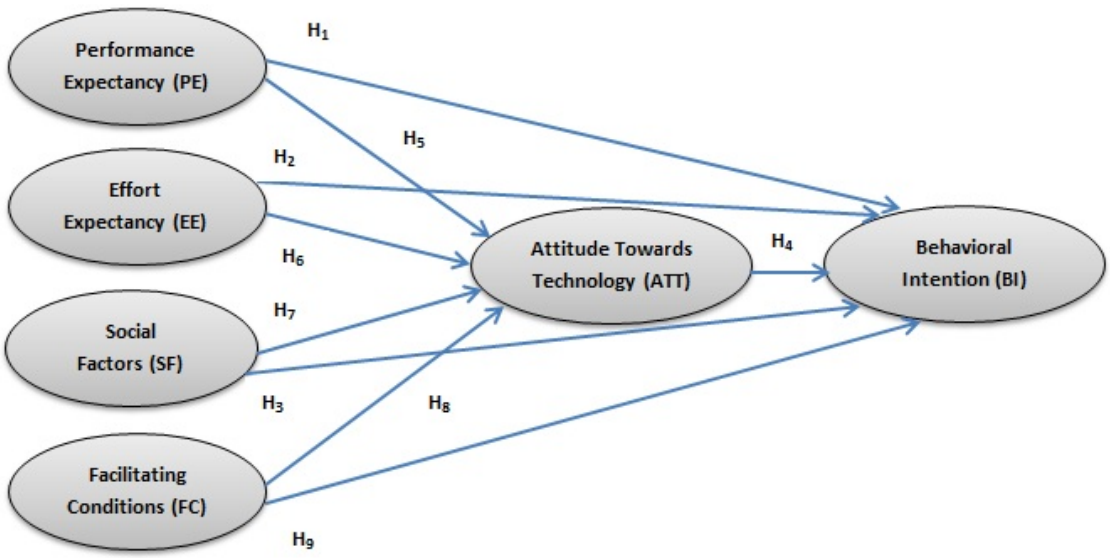

Figure 2: *Model 3 – The Effect of Attitude*

In total, three structural equation models with latent variables are estimated. In the first case, only the UTAUT factors (performance expectancy, effort expectancy, social factors, facilitating conditions) with effects on behavioural intention as indicated by Venkatesh et al. (2003) are included. This model provides preliminary tests of the first three hypotheses. In the second case, the facilitating conditions factor which according to Venkatesh et al. (2003) does not predict behavioural intention is inserted and the results are compared to those of the first model. This second model provides a preliminary test of Hypothesis 9 and a retest of the first three hypotheses with the effect of facilitating conditions on behavioural intention controlled. Finally, attitude is inserted, Hypothesis 4 to Hypothesis 8 are evaluated and each of the hypotheses tested in the previous models are re-evaluated with the effect of attitude on behavioural intention and the

effects of the UTAUT factors on attitude controlled. At the end of this sequence, the best model for the context under study is identified. However, before these models are estimated, the measurements of the latent variables based on the Guyanese data are re-evaluated (factorial validity) using confirmatory factor analysis. The full structural model including attitude (third model estimated) is depicted in
Figure *2*.

RESULTS

Factorial Validity of the UTAUT Constructs

The internal consistency (Cronbach α) of each of the factors exceeds 0.7 (see Table 2) and is hence adequate (Hair, Black, Babin, Anderson, & Tatham 2006). However, the initial confirmatory factor analysis model which includes performance expectancy, effort expectancy, social factors, facilitating conditions and behavioural intention results in a poor fitting model with respect to the $RMSEA$ and CFI ($\chi^2_{125} = 417.195,\ RMSEA = 0.085,\ CFI = 0.919$). A large modification index (136.372) occurs for the error covariance between the first two indicators of facilitating conditions (expected change 0.575). Freeing this covariance results in a drop in the Chi-square value of 157.33 for one degree of freedom and a significantly better fitting model overall ($\chi^2_{124} = 259.865,\ RSMEA = 0.058,\ CFI = 0.962$). The two items in question are similar in content. One of these items (FC1) is about support for MLearning at the university campus and the other (FC2) is about support at the level of the country (see Table 1). It is evident that the respondents see these two as overlapping. The correlation between the error terms therefore seems appropriate.

Although the revised model fits well overall, there is still a large modification index (48.656) for the covariance between the error terms of the third (PE3) and fourth (PE4) indicators of performance expectancy. In this case, one item is about improved performance while the other is about improved productivity (see Table 1). Apart from the possibility that the respondents may have misunderstood the difference between the two keywords, productivity and performance may well be correlated. We therefore free this covariance. The statistics and indices for the resulting model ($\chi^2_{123} = 216.611,\ RMSEA = 0.049,\ CFI = 0.974$) indicate that it is a better fit to the data.

The convergent validity of the items is judged based on the size of the standardised factor loadings (see

Table *2*). With the exception of three loadings, all the item loadings exceed 0.7 and hence, the items per factor show adequate convergent validity (Fornell & Larcker 1981). The average variance extracted (AVE) also exceeds 0.5 in each case except for the facilitating conditions factor (see

Table *2*). With the exception of facilitating conditions, the factors therefore show adequate convergent validity. The freed correlation between FC1 and FC2 results in a drop in the factor loadings for the two items and consequently in the low AVE. However, as highlighted earlier, the freed correlation is interpretable and it is also responsible for a substantially better fitting model. Overall, the data supports the formation of the UTAUT factors, but the low loadings for SF3, FC1 and FC2 are limitations on this study since these inflate the unexplained variance in the measurement models. In the case of the facilitating conditions construct, we use the third item to scale the factor in subsequently estimated models.

Table 2: *Items Loadings on the UTAUT Constructs*

Item	Performance Expectancy	Effort Expectancy	Social Factors	Facilitating Conditions	Behavioural Intention
PE1	0.744				
PE2	0.809				
PE3	0.773				
PE4	0.762				
EE1		0.860			
EE2		0.905			
EE3		0.878			
SF1			0.888		
SF2			0.935		
SF3			0.452		
FC1				0.374	
FC2				0.503	
FC3				0.779	
FC4				0.745	
FC5				0.741	
BI1					0.927
BI2					0.910
BI3					0.769
Average variance extracted	0.597	0.777	0.622	0.421	0.760
Cronbach alpha	0.875	0.911	0.789	0.797	0.899

The factor loadings are standardised using the STDYX standardisation.
See Table 1 for the items referred to in the first column of this table.

Table 3: *Discriminant Validity of the UTAUT Measurement Model*

	Performance Expectancy	Effort Expectancy	Social Factors	Facilitating Conditions	Behavioural Intention
Performance Expectancy	**0.773**				
Effort Expectancy	0.368	**0.881**			
Social Factors	0.635	0.356	**0.789**		
Facilitating Conditions	0.428	0.571	0.43	**0.649**	
Behavioural Intention	0.595	0.358	0.524	0.582	**0.872**

The square rood the average variance extracted is inserted on the diagonal and printed in bold.

To evaluate the discriminant validity of the factors, we compare the square root of the average variance extracted with the correlations among the factors (Fornell & Larcker 1981). Table 3 shows the correlations among the factors (off-diagonal elements) and the square root of the average variance extracted (diagonal elements). In each case, the square root of the average variance extracted exceeds the correlations of the respective factors with each of the other factors in the model. Discriminant validity is therefore achieved for each factor.

Model 1: The UTAUT Effects

In this step, we estimate a SEM such that performance expectancy, effort expectancy and social factors impact directly on behavioural intention. The results indicate that the model fits the data well ($\chi^2_{58} = 80.792, RMSEA = 0.035, CFI = 0.992$). This model explains approximately 40.3% of the variance in behavioural intention (see Table 4). This falls below the 70% suggested by Venkatesh et al. (2003), but the model still appears to be useful. Each of the structural regression paths are significant thus tentatively confirming the first three hypotheses. We note here, in particular, that social factors have a significant effect on behavioural intention even without the specification of interaction terms.

Model 2: The Effect of Facilitating Conditions

The second model which adds an effect of facilitating conditions on behavioural intention to the first model also fits the data well ($\chi^2_{123} = 216.611, RMSEA = 0.049, CFI = 0.974$). It explains approximately 49.8% of the variance in behavioural intention (see Table 4). The explained variance again falls below 70%. In spite of this, this second model is preferred to the first because it reduces the degree of uncertainty in the prediction of behavioural intention.

All the specified regression effects are not significant in this second model. The inclusion of facilitating conditions results in a non-significant direct effect of effort expectancy. The perceived ease of use therefore seems to be related to the environmental conditions such that once the latter is accounted for jointly with performance expectancy and social factors, effort expectancy (ease of use) ceases to significantly affect behavioural intention. This second form of the model tentatively confirms the ninth hypothesis. It is important to note that based in the UTAUT model proposed by Venkatesh et al. (2003), there should be no effect of facilitating conditions and effort expectancy should influence behavioural intention positively. These results tentatively confirm the first and the third hypotheses which are upheld by the first model, but contradicts the second hypothesis.

Model 3: The Effect of Attitude

The third model which adds an effect of attitude on behavioural intention and effects of performance expectancy, effort expectancy, social factors and facilitating conditions on attitude also fits the data well ($\chi^2_{172} = 321.928, RMSEA = 0.052, CFI = 0.967$). The standardized factor loadings for attitude are 0.864, 0.932 and 0.844 respectively which all exceed 0.7, and the construct has an average variance extracted of 0.776. The internal consistency (0.909) is also high and the square root of the average variance extracted (0.88) exceeds the correlation of attitude with each of the included factors. The measurement of this factor is therefore valid and reliable and it provides unique information in the model.

The third model explains approximately 58.3% and 59.3% of the variance in attitude and behavioural intention respectively. The percentage for behavioural intention again falls below 70%, but it is relatively high. In fact, the explained variance is substantially higher than in the first two models. Model 3 is therefore preferred for the evaluation of MLearning adoption in higher education in Guyana.

The inclusion of attitude changes some of the direct effects on behavioural intention, but it is more informative to look at the total (net) effects. Table 4 shows the effect sizes (standardised effects) for the impacts of the various factors on attitude and behavioural intention. As observed, performance expectancy, effort expectancy and facilitating conditions have significant positive effects on attitude. Therefore, students with more positive perceptions about the usefulness (performance expectancy) of the mobile technologies for learning, who find them easier to use (effort expectancy), and students with more positive views of the facilitating conditions have more positive attitudes towards the use of mobile technologies. On the other hand, the social factors (social factors) do not predict attitude towards the use of the technologies. These results confirm each of the hypotheses about effects on attitude except Hypothesis 6 (about social factors). Performance expectancy has the most substantial influence on attitude followed by effort expectancy then by facilitating conditions. Therefore, the perceived benefit of the use of the technologies to learning is the most important determinant of attitude towards the mobile learning technologies.

Table 4: *Structural Relationships*

Model	Dependent	Predictor				
		Performance Expectancy	Effort Expectancy	Social Factors	Facilitating Conditions	Attitude
Model 1	Behavioural Intention (R-sq = 0.430)	0.408** (0.071)	0.130* (0.055)	0.217** (0.070)		
Model 2	Behavioural Intention (R-sq = 0.498)	0.348** (0.069)	-0.05 (0.062)	0.150* (0.068)	0.397** (0.067)	
Model 3	Attitude (R-sq =0.583)	0.583** (0.063)	0.192** (0.058)	0.011 (0.065)	0.132* (0.065)	
	Behavioural Intention (R-sq=0.593)	0.080 (0.084)	-0.136* (0.058)	0.141** (0.062)	0.333** (0.063)	0.468** (0.073)
	Total Effect on Behavioural Intention	0.353** (0.069)	-0.047 (0.062)	0.146* (0.053)	0.395** (0.067)	0.468** (0.073)

The estimates are presented as effects sizes (standardized) with the standard errors in brackets. *Significant at the 5% level. ** Significant at the 1% level.

The total effects of performance expectancy, social factors, and facilitating conditions on behavioural intention are significant and positive. On the other hand, effort expectancy does not predict behavioural intention when the facilitating conditions are controlled. With attitude included, effort expectancy continues to have no net effect on behavioural intention. We therefore concede that the second hypothesis (about effort expectancy) is contradicted. With the exception of this hypothesis each of the hypotheses about the effects of the UTAUT factors on behavioural intention are confirmed. The directions of these effects are also consistent with those detected by Model 2. In addition, the significant positive impact of attitude confirms Hypothesis 4. In descending order of size, the significant net effects on behavioural intention are of attitude, facilitating conditions, performance expectancy and social factors.

DISCUSSION AND CONCLUSION

In this study, we find that the explanatory power of the UTAUT model falls below the 70% suggested by Venkatesh et al. (2003). However, interaction terms are not included (due to non-convergence during estimation). The inclusion of interaction terms can improve the explanatory power of the model, but substantial improvement is not guaranteed since the explanatory power can be low even with interactions included (for example, Teo 2011).

The results confirm several of the relationships in the UTAUT model as proposed by Venkatesh et al. (2003), but the UTAUT model is contradicted in four important ways:

- The facilitating conditions significantly affect behavioural intention even when the effects of performance expectancy and effort expectancy on behavioural intention are included.
- Effort expectancy does not have a significant effect on behavioural intention after the effect of the facilitating conditions is controlled.
- Interactions are not required for an effect of social factors on behavioural intention to emerge (consistent with Jairak et al. (2009) and Nassuora (2012)).
- Attitude significantly affects behavioural intention even with the inclusion of performance expectancy and effort expectancy (consistent with Jairak et al. (2009) and Nassuora (2012)).

Together these contradictions suggest that culture and country differences moderate the UTAUT relationships. The current study is conducted in a developing country while the UTAUT model and most MLearning studies are based on data collected in Western contexts. Resources are generally limited in developing countries and under such conditions, it is likely that the facilitating conditions will affect adoption. In this case, the findings are similar to those of Jairak et al. (2009) and Nassuora (2012). On the other hand, the results of studies from all non-Western countries are not the same. The lack of effect of effort expectancy on behavioural intention, in particular, appears to be unique to Guyana since for example, both Nassuora (2012) and Jairak et al. (2009) find that effort expectancy predicts behavioural intention even when the effects of the facilitating conditions and attitude are controlled. Furthermore, this particular result is in conflict with that reported by several studies (for example, Bandyopadhyay & Fraccastoro 2007; Im et al. 2011; Jairak et al. 2009; Nassuora 2012; Wang & Shih 2009). Omitting an effect of the facilitating conditions on behavioural intention as in the UTAUT model will lead to a spurious effect of effort expectancy in addition to the missed opportunity of recognising the importance of the facilitating condition to behavioural intention.

Attitude is not included in the original UTAUT model, but it has the largest effect on behavioural intention. Attitude towards the use of the mobile technologies for learning is hence the most important driver of adoption in the Guyanese context. Including an effect of attitude increases the explained variance for behavioural intention by 47.1% with respect to the first model and by 19.2% with respect to the second model. Further, without the inclusion of attitude, effort expectancy would be of no explanatory value in the current context. The model with attitude is the best of the three models tested for the study of MLearning adoption in Guyana. Although attitude is the most important predictor of behavioural intention, the remaining factors are also important since they either have significant net effects on behavioural intention or because they predict attitude. Facilitating conditions is the second most important determinant of behavioural intention. The facilitating conditions take precedence over both the usefulness (performance expectancy) and the effort expectancy (ease of use) of the technologies. Further, the usefulness of the technologies is more important in determining intention to adopt than how easy they are to use.

The differences between the UTAUT model as proposed by Venkatesh et al. (2003) and our findings suggest that to promote the adoption of MLearning, the context (country) must be

considered. This conclusion may also be inferred from the studies that find important cultural effects on the relationships in the UTAUT model (for example, Im et al. 2011; Al-Gahtani et al. 2007). MLearning adoption strategies should be based on analysis conducted in the particular context in order to optimise their effectiveness. Furthermore, whenever the UTAUT model is used, it is prudent to include all the effects (including facilitating conditions on behavioural intention) on an exploratory basis to avoid possible non-detection of important relationships and the possible detection of spurious relationships.

Efforts to advance the adoption of MLearning in higher education in Guyana should focus on improving attitude towards the use of the technologies for education and on ensuring that the facilitating conditions are addressed (supported by Jairak et al. (2009)). These two variables are the most important determinants of adoption in Guyana. However, improved attitude also results from improvements in the conditions, positive views on the usefulness of the technologies for learning (performance expectancy) and with acquisition of the appropriate skills (effort expectancy). Social factors also play a role in influencing adoption. Hence, the supportiveness of lecturers and colleagues is important in promoting the adoption of MLearning. Overall, efforts to advance MLearning adoption need to be holistic.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

This study has two important limitations. Firstly, the interaction terms are not included due to convergence issues during estimation. This means that the estimated models are not in the exact form as the original UTAUT model and as a result, the explained variance can be affected. Inclusion of the interaction terms may be successful if a larger data set is obtained. Secondly, the measurements are not adjusted for response styles and this can affect both the measurements of the factors and the relationships among the factors (Van Vaerenbergh & Thomas 2013; Thomas, Abts & Vander Weyden 2013). Response styles are the respondents' tendency use rating scales in systematic ways that are unrelated to the content of the items and they affect both the univariate and multivariate relationships in the data. Adjustments for response styles have not yet become common in the study of MLearning adoption and in this regard, the measurements in the current study are still consistent with the MLearning adoption literature. However, researchers should attempt to adjust the UTAUT measures for response styles in future research.

The findings of this study indicate a need for more cross-cultural evaluations of the UTAUT model to strengthen the current knowledge base. Such studies should focus simultaneously on Western and non-Western countries, but cross-national evaluation in non-Western countries alone will also be beneficial to the field. Apart from the Guyanese setting, there is also a need for similar studies on the UTAUT model in the Caribbean region.

The UTAUT factors (performance expectancy, effort expectancy, social factors and facilitating conditions) jointly explain 58.3% of the variance in attitude and 59.3% of the variance in behavioural intention. This presents the opportunity for research on additional variables that can predict the outstanding variance in these two factors. This line of research will advance the study of MLearning adoption and of technology adoption in general. The UTAUT model should also be investigated further in the Guyanese context, in domains other than MLearning in order to determine the generalizability of the results to technology adoption. Such studies should also attempt to determine whether modifications of the three items (SF3, FC1 and FC3) are necessary for the Guyanese context in general or if these low loadings are specific to MLeaning adoption.

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