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Predictive Path Model for Mobile Learning Applications

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Abstract: *Mobile technology has been widely used by the students for their studies. Hence to exploit the extensive use of mobile phones, the concept of mobile learning (M-learning) came into existence.M-learning is the learning that takes place with the aid of mobile phone. It is basically the extension of e-learning. We focussed on M-learning applications which can be utilized by the students. We classified M-learning applications in five types. Those are- Learning Management, Supportive, Content-Based, Context-Based and Collaborative. They cover all the applications for the academic purpose.We need to find out acceptance of these applications.The first objective of this study is to investigate and identify the factors which affect students' acceptance of M-learning. The second objective is to examine the relationships between different variables impacting the acceptance of M-learning. This led to the research questions as what are the factors that determine student acceptance of M-learning and out of those which factors are the most important or have the most influence. There are total ten research hypotheses which determine the relationships between each type of application with perceived usefulness and perceived ease of use of M-learning. The method uses a personally administered survey using a questionnaire. The results are displayed using extended Technology Acceptance Model (TAM) developed during the research.Overall; the results validate the power of TAM constructs and its appropriateness for predicting acceptance of M-learning. The findings of the research have added the knowledge base and theory of M-learning and technology acceptance. The study confirmed the strength of TAM in predicting acceptance of M-learning.*

Keywords: *M-learning, TAM, Usefulness, Ease of Use, Predictive Path Model*

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I. Introduction

Mobile-learning (M-learning) is seen as either an extension of e-learning which traditionally meant learning that takes place at a computer or a completely new paradigm that lets someone learn anywhere and at any time. Constable et al. (2008) define m-learning as "the combination of e-learning and mobile computing".Yordanova (2007) defines m-learning as "learning that is wireless and ubiquitous"[1]. Wains and Mahmood (2008) define m-learning as "a type of e-learning which blends wireless and mobile technology for learning experience"[2].Deegan and Rothwell (2010) give a definition of m-learning as "Learning with the aid of a mobile device"[3].Deegan and Rothwell (2010) have classified m-learning into five categories in terms of usability aspects and these classifications include-Learning Management, Supportive, Content-based, Context-based and Collaborative. Using the mobile device in order to register for courses, view grades, retrieve homework, submit assignments and annotate common artefacts fall under the Learning Management category of M-learning. Using the mobile devices for supporting traditional learning (in classroom or lecture hall), e-learning or distance learning like direct communication between lecture and student falls under the supportive category of e-learning. Wains and Mahmood (2008) describes the use of SMS system to supplement real-time TV learning which comes under this category. The same paper notes the use of SMS in English lesson in Japan and in distance education in Philippines as a supportive tool. Viewing video recordings of class lectures through mobile comes under the content-based category of m-learning. Context-based learning is a true mobile learning environment. A context-based learning application will focus learning objectives in the environment in which it is being used. Morrison et al.(2009) talks about context based application of M-learning describing how users of a mobile device can use the camera function to display a map in real time while application overlays meta-data on the map. Collaborative learning refers to the notion that a learner is not a passive participant when learning but takes an active part in the learning process as per Deegan and Rothwell (2010).Participating in forum discussion using a mobile device is an example of Collaborative usability of M-learning.

II. Objetctives

Relating to the problem statement, this study will focus on students at institutions of higher education in order to understand students' perceptions of mobile learning and factors that influence its acceptance. Understanding the relationships between the different factors will help us identify which ones influence students' acceptance of mobile learning. This study will build on tested theories in technology acceptance to determine which factors play an important role in determining students' acceptance of mobile learning services. In view of how different factors relate to student acceptance of mobile learning, this study has the following objectives:

(1) To investigate and identify the extent of use of mobile technologies by students.
(2) To investigate and identify the factors which affect students' acceptance of mobile learning.
(3) To examine the relationships between different variables impacting the acceptance of mobile learning.

III. research questions

Mobile learning is new educational technology.More rigorous research is needed to understand student perceptions.Research addressing students' perceptions of mobile learning is scarce and mainly is in the form of case studies.It is important to understand students' perceptions of mobile technologies and mobile learning because it can be used to determine the factors those are likely to be influenced by the charactersistics of mobile devices,students' skill levels and the interaction with other users.

There is a need to study the factors that determine the acceptance of mobile learning, so that the university administrators and IT staff can incorporate acceptance factors into the university implementation of mobile learning.Therefore this leads to the following research questions:

1. What are the factors that determine student acceptance of mobile learning?

Once these factors are determined, there is a need to identify the most influential factors for mobile learning acceptance.All the factors will not affect mobile learning acceptance to the same extent.The findings from this question can help the university determine where resources should be dedicated and thus help ensure success. The following research question addresses this issue:

2. Which factors are the most important or have the most influence on student acceptance of mobile learning?

The problem statement acknowledges that students of all groups have developed much more sophisticated expectations, demands and study patterns than ever before because of their different literacies and the regular use of mobile technologies and the web.

IV. literature review

Presently, very few studies have been done in Indian context to assess the usability of mobile learning. The authors examined Indian students' willingness to use M-learning and investigated their expectations. The findings revealed that a section of the target audience is positive towards m-learning. Greater awareness of features, price etc. of the proposed service might find adequate number of customers for m-learning solutions in a market such as India (Venkatesh, Nargundkar, Sayed & Shahaida, 2006)[4].The researchers studied the potential of m-learning in enhancing the quality of higher education. The perspective and experience of students towards an actual implementation of m-learning was also taken in the study. Recommendations were made towards where all m-learning could be useful in bridging about a change in higher education (Gupta & Manjrekar, 2012)[5].

WAP and PDA based technologies are not popular in India due to costs involved and less expensive SMS based mobile technologies hold tremendous potential for student retention. Students' attitudes and perceptions towards the effectiveness of m-learning have to be understood and measured. The authors suggested use of micro learning blended with distance education using mobile systems for support(Fozdar & Kumar,2007)[6].To study M-learning in distance education libraries, a case study of IGNOU was done by Chandok and Babbar(2011)[7].The proposed m-library services architecture suggested developing an M-library website at IGNOU library, hence strengthening the m-learning in Distance Education System. The study proposed a model for providing e-resources and other information services through mobile technology to its learners in IGNOU, India.

A model was proposed for integrating mobile technology in day-to-day education management (including course delivery).The model was proposed to automate processes like attendance registering, testing the students' knowledge and other academic related activities using mobile technologies. The author, Shubhabaha Pal (2010) concluded that with the ubiquitous presence of mobile technologies around us and students' acceptance and comfort, m-learning can be very handy for improvement in quality in higher education.

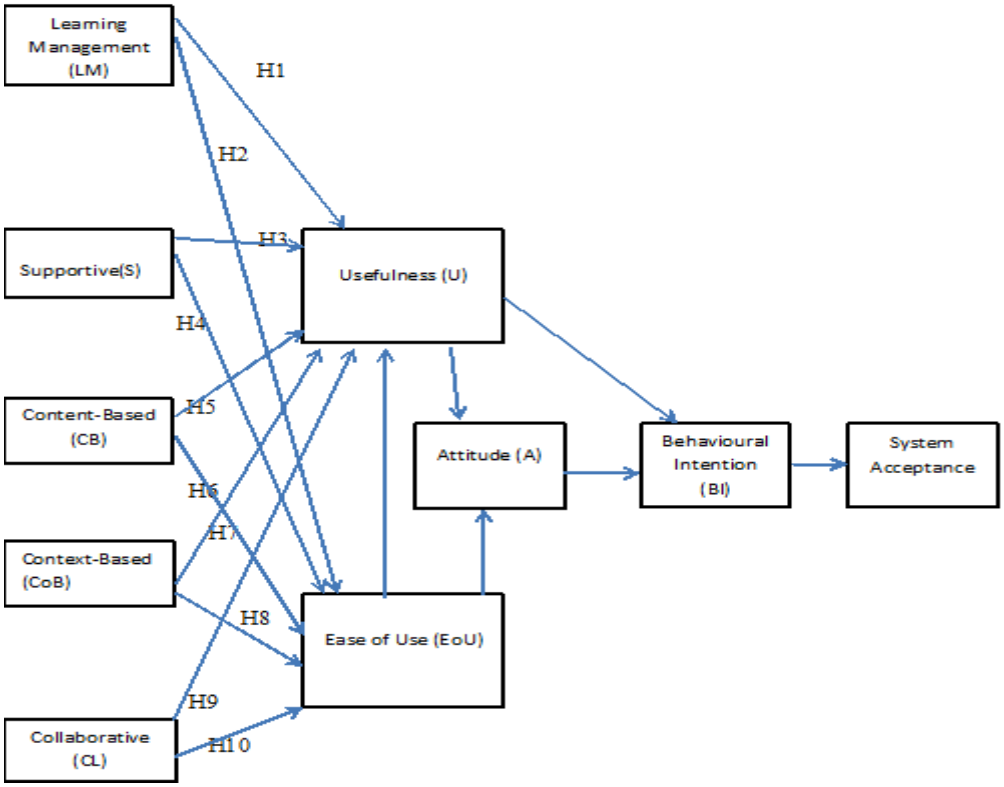

Figure1:Extended TAM model[8]

V. HYPOTHESES

Learning Management Hypotheses
H1: Learning management applications will be positively related to perceived usefulness of mobile learning.
H2: Learning management applications will be positively related to perceived ease of use of mobile learning.
Supportive Hypotheses
H3: Supportive applications will be positively related to perceived usefulness of mobile learning.
H4: Supportive applications will be positively related to perceived ease of use of mobile learning.
Content-Based Hypotheses
H5: Content-Based applications will be positively related to perceived usefulness of mobile learning.
H6: Content-Based applications will be positively related to perceived ease of use of mobile learning.
Context-Based Hypotheses
H7: Context-Based applications will be positively related to perceived usefulness of mobile learning.
H8: Context-Based applications will be positively related to perceived ease of use of mobile learning.
Collaborative Hypotheses
H9: Collaborative applications will be positively related to perceived usefulness of mobile learning.
H10: Collaborative applications will be positively related to perceived ease of use of mobile learning.

VI. METHODOLOGY

The research is quantitative in nature.Gay et al. define quantitative research as the collecting and analyzing numerical data in order to explain,predict, and/or control phenomena of interest.This research is concerned with finding the determinants of mobile learning acceptance and understanding how different factors relate to student perception and acceptance of mobile learning.Thus, quantitative methods are used to investigate attitudes,discover factors and relationships between the factors, and compare similarities and differences across student groups in different colleges and different gender and age groups.

The research is descriptive and correlational. According to Gay et al. (2006), descriptive research determines and reports the way things are: it involves collecting numerical data to test hypotheses or answer questions about the current status of the subject of study. Assessing the preferences, attitudes, practices, concerns, or interests of groups of people are examples of descriptive research.Descriptive research data is mainly collected through questionnaire data, an interview, or observation.The research in this study is survey-based, using a measurement instrument developed for collecting data.

Multiple regression analysis is used to find the predictors (i.e. independent variables) of usefulness and ease of use (i.e.dependent variables) as hypothesized in the research model (Hair et al., 1992).The regression analysis tests were performed between the independent and dependent variables in the research model.The dependent variables are usefulness (U) and ease of use(EoU).The coefficient of determination (R^2) measures the proportion of the variance of the dependent variable about its mean that is explained by the independent or predictor variables (Hair et al., 1998).The higher the value of R^2, the greater the explanatory power of the regression model.The model is statistically significant.The values of the regression coefficients and their significance determine the variables included in the model.

VII. FINDINGS (RESULTS)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.724	.144		11.947	.000
	Learning Management	.523	.038	.523	13.925	.000
2	(Constant)	1.358	.163		8.330	.000
	Learning Management	.435	.042	.435	10.427	.000
	Context - Based	.181	.040	.188	4.521	.000
3	(Constant)	1.258	.168		7.507	.000
	Learning Management	.392	.045	.391	8.668	.000
	Context - Based	.134	.044	.140	3.029	.003
	Content - Based	.115	.048	.118	2.413	.016

a. Dependent Variable: Ease of Use

Equation:

EoU = 1.258 + 0.392 (LM) + 0.134 (CoB) + 0.115 (CB)

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Supportive	.117[b]	2.589	.010	.113	.680
	Content - Based	.183[b]	4.125	.000	.179	.691
	Context - Based	.188[b]	4.521	.000	.195	.782
	Collaborative	.149[b]	3.708	.000	.161	.856
2	Supportive	.057[c]	1.194	.233	.053	.605
	Content - Based	.118[c]	2.413	.016	.106	.558
	Collaborative	.097[c]	2.297	.022	.101	.751
3	Supportive	.019[d]	.368	.713	.016	.529
	Collaborative	.072[d]	1.619	.106	.071	.675

a. Dependent Variable: Ease of Use

b. Predictors in the Model: (Constant), Learning Management

c. Predictors in the Model : (Constant), Learning Management, Context – Based

d. Predictors in the Model : (Constant), Learning Management, Context – Based

The regression model supports the following hypotheses :

H2: Learning Management applications will be positively related to perceived ease of use of mobile learning (Beta=0.391, t<0.05).

H6: Content-Based applications will be positively related to perceived ease of use of mobile learning. (Beta=0.118, t<0.05).

H8: Context-Based applications will be positively related to perceived ease of use of mobile learning (Beta=0.140, t<0.05).

The following hypotheses are not supported:

H4: Supportive applications will be positively related to perceived ease of use of mobile learning (t=0.713, not significant).

H10: Collaborative applications will be positively related to perceived ease of use mobile learning (t=0.106, not significant).

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.986	.162		6.104	.000
	Content - Based	.723	.041	.611	17.512	.000
2	(Constant)	.543	.160		3.387	.001
	Content - Based	.517	.046	.436	11.274	.000
	Collaborative	.343	.041	.326	8.416	.000
3	(Constant)	.260	.170		1.528	.127
	Content - Based	.417	.050	.352	8.289	.000
	Collaborative	.302	.041	.287	7.349	.000
	Context - Based	.212	.047	.181	4.477	.000
4	(Constant)	.166	.173		.959	.338
	Content - Based	.362	.055	.306	6.642	.000

	Collaborative	.286	.041	.272	6.916	.000
	Context - Based	.189	.048	.162	3.939	.000
	Supportive	.118	.048	.105	2.483	.013

a. Dependent Variable: Usefulness

Equation:

U = 0.166 + 0.362 (CB) + 0.286 (CL) + 0.189 (CoB) + 0.118 (S)

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Learning Management	.112[b]	2.692	.007	.118	.691
	Supportive	.201[b]	4.613	.000	.199	.616
	Context – Based	.248[b]	5.983	.000	.255	.662
	Collaborative	.326[b]	8.416	.000	.348	.714
2	Learning Management	.075[c]	1.890	.059	.083	.681
	Supportive	.137[c]	3.256	.001	.142	.592
	Context – Based	.181[c]	4.477	.000	.194	.629
3	Learning Management	.043[d]	1.076	.283	.047	.656
	Supportive	.105[d]	2.483	.013	.109	.570
4	Learning Management	.015[e]	.356	.722	.016	.598

a. Dependent Variable: Usefulness
b. Predictors in the Model: (Constant), Content - Based
c. Predictors in the Model: (Constant), Content - Based, Collaborative
d. Predictors in the Model: (Constant), Content - Based, Collaborative , Context - Based
e. Predictors in the Model: (Constant), Content - Based, Collaborative , Context - Based, Supportive

Table 3: Regression results for dependent variable usefulness (U)

The regression model supports the following hypotheses:

H3: Supportive applications will be positively related to perceived usefulness of mobile learning. (Beta =0.105, t<0.05)

H5: Content-Based applications will be positively related to perceived usefulness of mobile learning. (Beta=0.306, t<0.05)

H7: Context-Based applications will be positively related to perceived usefulness of mobile learning. (Beta=0.162, t<0.05)

H9: Collaborative applications will be positively related to perceived usefulness of mobile learning. (Beta=0.272, t<0.05)

The regression model does not support the following hypothesis:

H1: Learning management applications will be positively related to perceived usefulness of mobile learning (t=0.722, not significant)

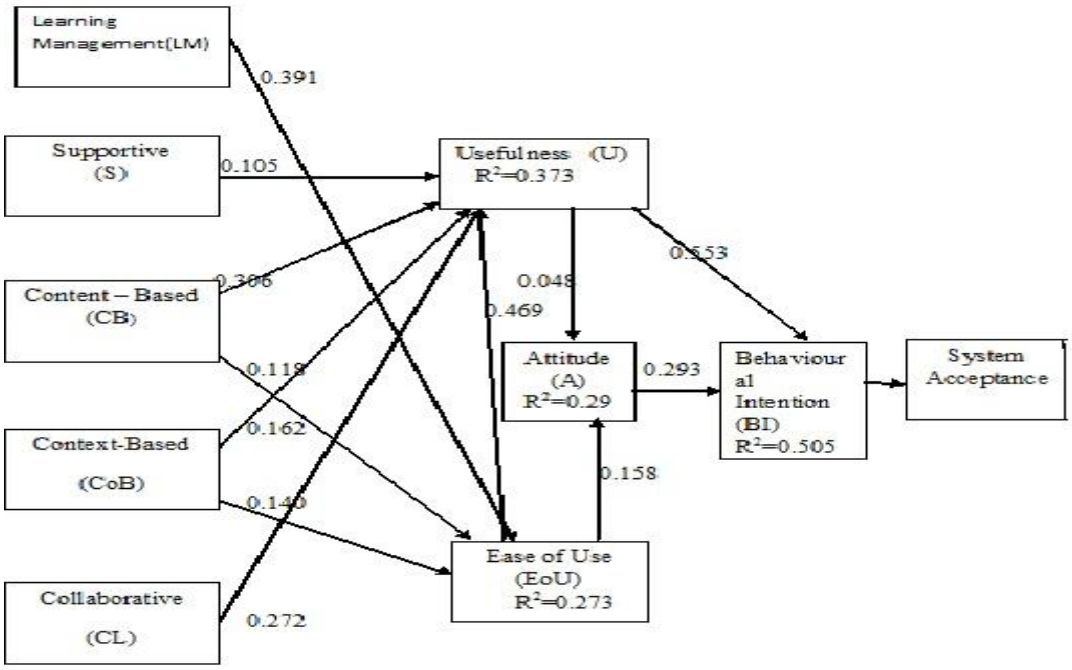

Fig.2. Predictive Path Model

VIII. Conclusions

The results of this study suggest that the external factors of Learning Management,Supportive,Content-Based,Context-Based and Collaborative contribute to all determinants of M-Learning acceptance.TAM factors of perceived usefulness and perceived ease of use,validated through numerous other studies,were also determined to be significant determinants of M-Learning acceptance.The study revealed that the TAM construct usefulness is the most significant predictor of behavioral intention and thus acceptance.It presents the explanatory strength of the research model as well as the relationships between the variables investigated.The model explains 56.5 % of the variance in behavioral intention to use M-Learning,which has been shown to be a strong predictor of actual use.This answers the first question which means that all the external factors are more or less significant.

Research question two was addressed by the research finding that the external variables supportive, content based, context based and collaborative are the most significant predictors of usefulness.The external variables learning management, context based are the most significant predictors of ease of use respectively.

Universities can use the framework developed in this research to narrow the gap between the university and students. Universities can focus their resources in the areas that most influence acceptance of M-Learning and they can incorporate these requirements early on in the process. Doing so will help universities achieve success with M-Learning implementations ,both fiscally and educationally. Developers and manufacturers of M-Learning equipment and software can also benefit from the research model and findings by understanding and incorporating these factors early in their process

Limitations

1. This study does not investigate actual usage but rather prediction of use through invention. Although this is a limitation, the causal link between intention and actual behavior has been substantially empirically supported through prior research (Venkatesh & Davis, 2000; Taylor & Todd, 1995; Davis et al., 1989).
2. Participants self reported their answers to the research instrument. Bias effects could be present.
3. The research model was limited to investigating the external variables as exogenous variables where they cannot act as mediators. This resulted in the exclusion of the construct Learning Management (for usefulness) and Supportive, Content Based and Collaborative (for ease of use) from the predictive model.
4. The study is limited geographically to University of Mumbai, India.

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