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Behavioural Intention to Adopt Mobile Technology among Tertiary Students

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Abstract: This research aims to investigate the factors that influence the behavioral intention of the adoption of Mobile Technology in the Learning Environment (MTLE) of Malaysia. The rapid growth of Third generation (3G) mobile technology has radically changed the lifestyle of our students. 3G mobile technology incorporates voice data and Internet access, making smart phones similar to personal computers. These mobile features attract the patronage of the entire student population. As a result, Malaysia has the second-highest number of phone users in the region. This study aims to identify the determinants that influence MTLE adoption and propose the incorporation of such technology into the educational environment of students and universities. A total of 351 participants from private universities participated in the study. The Modified Unified Theory of Acceptance and Use of Technology (UTAUT) model is adopted to determine the factors that influence the behavioral intention behind the use of MTLE. The result indicates that performance expectancy, affordability and pedagogy have a significant impact on student adoption of MTLE. Moreover, there is no significant effect on both age and gender as moderators is observed. This paper is a significant contribution to the UTUAT model. In addition, it addresses educational issues with regard to the shift from a traditional learning environment to a blended learning environment.

Key words: Mobile technology · Pedagogy · UTAUT · Affordability

INTRODUCTION

The introduction of the third generation mobile technology (3G) caused significant increase in the sales of smart phones. New features include dedicated gaming devices, personal media players, Internet connectivity, e-book features and GPS functionality. The market is dominated by these new and innovative handheld mobile phones, which are constantly and rapidly upgraded in terms of cost, user-friendly interface, high processing speed, peripherals, on-board memory, internal storage, motion sensors and wireless broadband connectivity [1]. The fourth generation mobile technology (4G) is currently being introduced, which boasts of speed that is three to five times higher than 3G. 4Gis capable of wireless broadband Internet access, MMS (multimedia messaging service), video chat, mobile television, HDTV (high definition television), DVB (digital video broadcasting) and real-time audio. These features attract numerous patrons, particularly the young generation. Nowadays, seeing a college student without a mobile phone is a rarity. These students spend most of their time using their mobile phones for text messaging, gaming and interacting in social networks. Given the increasing growth of mobile communities, universities and instructors are now faced with the challenge of incorporating the use of mobile technology in the learning environment (MTLE). Relevant questions include, “Are these students willing to adopt mobile devices for learning purposes?” and “What are the factors that influence these students to adopt mobile technology into their learning environment?” The research is aimed to address the issues of incorporating MTLE. Today’s students must be creative in terms information gathering and they can access information through e-books, m-blogging, Face book, YouTube and MySpace. Although several smart phones offer these features, students seldom use these features for educational purposes. Therefore, the factors that influence MTLE should be investigated.

Outline of Previous Develoment: Mobile learning is rewarding especially when the student is on the move or in a nonspace, because it provides on-the-spot access to information. It is valuable for just-in-time learning or learning in emergency situations (i.e, first aid). The term “non space” refers to bus stands, airport waiting room

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and hotels [2]. Corbeil and Valdes-Corbeil [3] reported that mobile learning not only enhances interaction between students and instructors, but also assists students in accessing information at any given time or place, thereby reducing cultural and communication barriers.

Qunin [4] introduced m-learning 12 years ago, which paved the way for a number of projects and studies. However, the implementation of mobile technology is still at the initial stage. Hence, determining the factors that influence the behavior adoption of MTLE is necessary. Literature review shows that a number of studies have been conducted on the factors influencing the adoption of MTLE; however, these studies focused on SMS adoption [5] in Malaysia, MMS adoption[6] in Taiwan and determinants of adopting mobile technology [2] in the United States. Liu [7] from China focused on the adoption of mobile learning in solving puzzles. These studies concentrated on the use of SMS and MMS in the learning environment. Therefore, these studies are not fully applicable in the implementation of MTLE. Akour [8] focused on system quality, as well as the perception of the university and the students on the adoption of mobile learning in the United States; these factors proved to be significant for the adoption of mobile learning. However, the researcher ignored the important factors, such as affordability and pedagogy.

Learning via mobile technology will be unsuccessful without pedagogy, which is the most important factor in adopting MTLE. 3G mobile technology enables users to download audio or video files through the Internet. Learning through audio and video is called podcasting [9]. Podcasts allow learners to proceed at their own pace, listening to the audio or video as many times as they need to grasp the materials [10]. Podcasts improve the learning experience in terms of time and place, which is probably the biggest advantage of mobile technology. Podcasts help students prepare for their classes and reinforce the learning after class [11]. Affordability is one of the key factors that customers consider in choosing mobile services aside from ease-of-use and usefulness. The cost of service providers and the prices of smart phones are essential factors that affect consumer behavior. According to Volery and Lord [12], student adoption of technology is based on the satisfaction derived from using the device, flexibility, self-confidence, self-efficacy and participation. However, the affordability and pedagogical factors of the technology were not considered in previous studies. These missing variables created a gap for a new interest in the adoption of MTLE.

Zulkefly and Baharudin [13] conducted a study in Malaysia to investigate the use of mobile phones and its psychological effects among students. The study revealed that students preferred to communicate through SMS rather than through a voice call because of cost. Likewise, students were easily attracted to mobile phone features, to which they were addicted. Saipunidzam *et al*. [14] conducted a study on teaching mathematics for primary school students aged 11 to 12 years using the open-source technology in mobile phones. Both teachers and students were provided with handheld devices. Students used a mobile device in learning mathematics. They were also allowed to do their assignments at home and then send the assignments to their teachers. The mobile application is used to keep track of student progress and performance at a minimum cost. The results showed a significant improvement in terms of learning outcomes and satisfaction compared to the traditional approach. Similarly, mobile learning was found to share the advantages of the mobility of the device, which gives students the freedom to access learning materials anywhere at any time. Ismail *et al*. [15] conducted an action research on the adoption of SMS among long-distance education students in University Sains Malaysia. The learning characteristics and design were examined based on communication, convenience, enjoyment, satisfaction, quality, pace and reliability. The effects of learner characteristics, learning design and learning environment on adoptability were investigated. Educational messages were sent to the students through mobile phones. The mobile learners easily accessed information whenever they needed. The students stated that messages received through SMS were easily remembered. These results showed that m-learning helps students to pace their studies. SMS educational content was also found to satisfy the students. The participants enjoyed receiving messages through their handheld phones and expressed their willingness to adopt mobile devices in the learning environment. Open university Malaysia (OUM) conducted a survey on nationwide in their centre's and the resulted shows that 82.8 percent of the students are willing to adopt mobile learning and the university has introduced mobile learning by sending messages through SMS.

Theoretical Framework of the Study: This study used a modified UTAUT model, which was developed by Venkatesh *et al*. [16]. The model was developed through a review and consolidation of the constructs of eight models that had been employed to explain IS usage

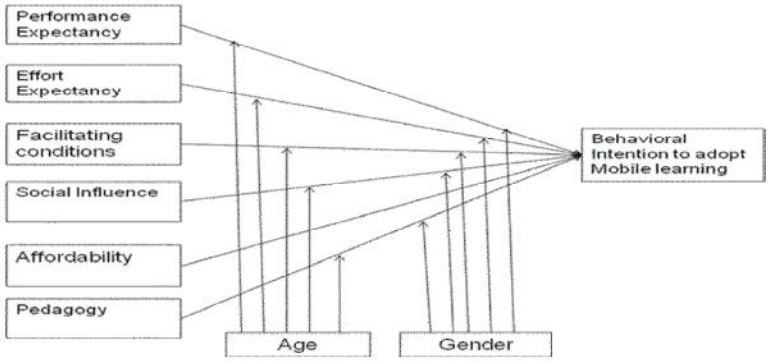

Fig. 1: Frame work of the study

behavior. The theory holds that four key constructs (performance expectancy, effort expectancy, social influence and facilitating conditions) are direct determinants of usage intention and behavior [17]. Affordability and pedagogical are two constructs that were added to the UTAUT model to determine the factors that influence the behavioral intention to adopt MTLE. Gender and age were used as moderating variables in this study. Figure 1 shows the frame work of the study.

The Study Attempt to Answer the Following Research Questions:

- What are the salient factors that influence the behavioral intention to adopt mobile technology in the learning environment among the undergraduate students in Malaysia?
- Does gender play a role in the behavioral intention to adopt mobile learning?
- Does age play a role in behavioral intention to adopt mobile learning?

Performance Expectancy: Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to improve their performance [18]. In studies on mobile learning, perceived usefulness is demonstrated to be a more important factor in adopting MTLE [2, 8, 19]. In the current study, performance expectancy pertains to the degree to which students believe that the perceived usefulness of using mobile technology will help them improve their performance. Mobile phones allow students to access learning materials and stay connected with the campus. The introduction of 3G and 4G has created opportunities for virtual classes, note-taking and downloading course materials using mobile phones. Hence, the following hypothesis was put forward:

H1a: Performance expectancy has a positive influence on behavioral intention.

Effort Expectancy: Effort expectancy is defined as the degree of ease-of-use related with technology [17,20-23] In the current study, effort expectancy refers to the extent to which students believe the mobile phone's ease-of-use and self-efficacy. Prior empirical studies show [9,24,25] that effort expectancy is apparently a more important determining factor in MTLE. Based on these studies, the following hypothesis was formed:

H2a: Effort expectancy has a positive influence on behavioral intention.

Social Influence: Social influence denotes the degree to which an individual believes others' perceived belief on the importance of the use of the new system [22]. Prior studies confirm that a significant positive relationship exists between social influences and the intent to use mobile devices, services and learning [8, 25-28]. Thus, the following hypothesis was formulated:

H3a: Social influence has a positive influence on behavioral intention.

Facilitating Conditions: Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system [22]. According to the literature review, facilitating conditions are empirically identified as direct determinants of adopting behavior. Prior research suggests that the success of m-learning depends on institutional support, including the conversion of learning materials into mobile formats, staff training and technical support [7,14,29]. Taking this premise into consideration, the following hypothesis was formed:

H4a: Facilitating conditions have a positive influence on behavioral intention.

Affordability: The current study aims to ascertain the factors that influence MTLE adoption. Therefore, two additional constructs identified from the literature review are addressed below. In this study, affordability refers to service provider's charges, as well as the cost of the mobile phone. Wagner [30] identified cost to be the foremost hindrance to the implementation of m-learning. Sharples [22] and Pagani [31] argued that cost is the third-important factor considered by customers in choosing mobile services, following ease-of-use and perceived usefulness. Cost of the service providers and charges of phone demonstrated the negative impact of using technology on behavioral intention [32]. Based on the aforementioned information,the present study formulated the following hypotheses:

H5a: Affordability has a positive influence on behavioral intention.

Pedagogy: In the present study, pedagogy refers to the extent to which an individual perceives he or she believes the usefulness of video and audio lectures, self-management and time shifting. University students of the current generation are completely different from those in the previous generations. Students from the current generation develop hyperactive minds. They prefer visual communication and spend a significant amount of time playing computer games. Moreover, they prefer to obtain information on their own, rather than to rely on others to give it to them. Mobile device components, such as audio and video, facilitate the time-sharing of lectures outside the classroom. Audios and videos can be used as synchronous pedagogical tools. Students can record lectures, which they can replay any time they prefer to do so. Thus, podcasted lectures become portable and are re-tooled as new forms of pedagogy [16, 33] Herrington *et al*. [34] argued that an urgent need exists to identify the pedagogies that can be integrated with the use of mobile technologies in the context of authentic approaches. Therefore, determining the kind of pedagogical style that students expect for adopting MTLE is necessary. Facer *et al*. [35] reported that mobile learning increases learner autonomy and self-direction learning capacity. As a result, the following hypothesis was formed:

H6a: Podcasting has a positive influence on behavioral intention.

Moderator Effects: Venkatesh *et al*. [16] proposed four moderating variables in the UTAUT model, namely, experience, voluntariness of use, age and gender. The inclusion of all four moderators in the current study is not feasible, because the respondents of this study are students who have yet to use MTLE. Thus, voluntariness and experiences of the user were not applicable in this study.

This study aims to investigate the factors influencing the behavioral intention of undergraduate students to adopt MTLE. Thus, the study is not a longitudinal study that intends to verify the effect of experience of the user, as well as the availability of different time periods.

Age as Moderator: Venkatesh *et al*. [16] suggested that age affects the willingness of users to adopt new IT products. Findings indicated that younger workers display more enthusiasm toward new IT products compared to older workers. Wang *et al.* [36] asserted that age and gender influence behavioral intention to adopt mobile learning. Bigne *et al*. [9] from Spain reported a significant age difference among the consumers of mobile technology. Cavus *et al*. [37], however, found no statistical difference between gender and age group. Based on the above information, ascertaining the moderating effects of age is necessary; thus, the following hypotheses were put forward:

H1b: The effect of performance expectancy on behavioral intention is moderated by age.

H2b: The effect of effort expectancy on behavioral intention is moderated by age.

H3b: The influence of social influence on behavioral intention is moderated by age.

H4b: The influence of facilitating conditions on behavioral intention is moderated by age.

H6b: The influence of podcasting on behavioral intention is moderated by age.

Gender as Moderator: Prior empirical studies proved that gender affects the behavioral intention of using technology [9,10,16,38,39,41]. Gender differences moderate the effects of social influence, as well as the self-management of mobile learning. Li and Kishore [42] revealed that a significant variance is observed between gender groups on effort expectancy, gender groups

performance expectancy, effort expectancy and social influences on the IT knowledge in Hong Kong. However, Cavus, *et al*. [37] reported no statistical difference between genders. Based on the above contradicting information, the moderating effect of gender should be ascertained.

H1c: The influence of performance expectancy on behavioral intention is moderated by gender.

H2c: The influence of effect of effort expectancy on behavioral intention is moderated by gender.

H3c: The influence of social influence on behavioral intention is moderated by gender.

H4c: The influence of facilitating conditions on behavioral intention is moderated by gender.

H6c: The influence of podcasting on behavioral intention is moderated by podcasting.

Research Methodology: A total of 1,100 structured questionnaires were sent to the undergraduate students in the private universities in Selangor and Kula Lumpur. 351 questionnaires were selected randomly using computer generated program. The participants consist of 45 percent females and 55 percent males.

Survey Instrument: The survey questionnaire was developed based on previous studies. Five-point Likert scales ranging from strongly agree, agree, neutral and disagree to strongly disagree were used to measure the items. The scale measured performance expectancy(PE), effort expectancy (EE),social influences(SI), facilitating conditions (FC), affordability(A), pedagogy(P) and behavioral intention(BI).Survey instruments were modified and reworded to meet the requirements of the current study [5,43,44].

Data Analysis: In the present study, SEM was used to test the conceptual model framed for behavioral intention in adopting MTLE. The application of SEM includes causal modeling or path analysis, which aided in examining the causal relationships between different variables, confirmatory factor analysis, correlation structure models and so on. AMOS was used for the analysis of confirmative factor analysis (FL), composite reliability (CR) and Average Extracted Variance (AVE). Table 1 shows the instrument reliability.

Table 1: Instrument reliability

	F.L	C.R	AVE	C.A
S1	0.73			
S2	0.80			
S3	0.86	0.83	0.64	0.81
EE	10.74			
EE	20.64			
EE	30.80			
EE	40.76	0.83	0.55	0.78
P1	0.73			
P2	0.70			
P3	0.80	0.92	0.55	0.80
FC	10.70			
FC	20.74			
FC	30.76			
FC	40.75	0.83	0.56	0.81
A2	0.60			
A3	0.67			
A4	0.65			
A5	0.65	0.74	0.51	0.79
PE	10.66			
PE	20.56	0.72	0.50	0.80

Table 2: Model fit indices

Model fit indices	xƛ/df	CFI	TLI	RMSEA
Recommended value obtained	<3 1.779	>.9.930	>9.920	<0.08.048

All factors in the measurement model have adequate and convergent reliability, because factor loading falls between 0.06 and 0.8, composite reliability (CR) is more than 0.6 and AVE is greater than 0.5 and A and PE is equal to 0.5. Table 1 shows that each construct was able to meet the internal consistency reliability requirement.

Model Fit: The proposed model was assessed using chi-square to test the adequacy of a hypothesized model in terms of the covariance of data. Table 2 shows the model fit indices and the results showed that the CFI was 0.93,TLI was 0.92 and RMSEA was 0.48. According to Joreskog and Sorborn [45], the recommended root mean square error is between 0.05 and 0.08;the recommended value of TLI is higher than 0.90; and the recommended value of CFI is higher than 0.09 [46]. Therefore, the proposed model fit to the data and was acceptable.

The results predicted that performance expectancy (β = 0.672, $p<0.05$), affordability (β = 0.664, $p<0.01$), pedagogy (β = 0.328, $p<0.05$), effort expectancy

Moderated Effects: The study investigated the moderated effects of age and gender. Moderator is a variable that affects the direction as well as the strength and weakness of the relationship between an independent and a dependent variable [3,47]. In testing the moderating effect

Table 3: Summary of hypothesis testing

H1a	Performance expectancy has a positive influence on behavioral intention.	Supported
H1b	The influence of performance expectancy on behavioral intention is moderated by age.	Not supported
H1c	The influence of performance expectancy on behavioral intention is moderated by gender.	Not supported
H2a	The effort expectancy has a positive influence on behavioral intention.	Not supported
H2b	The influence of effort expectancy on behavioral intention is moderated by age.	Not supported
H2c	The influence of effort expectancy on behavioral intention is moderated by gender.	Not supported
H3a	Facilitating conditions have a positive influence on behavioral intention.	Not supported
H3b	The influence of facilitating conditions on behavioral intention is moderated by age.	Not supported
H3c	The influence of facilitating conditions on behavioral intention is moderated by gender.	Not supported
H4a	Affordability has a positive influence on behavioral intention.	Supported
		Supported
H5a	The social influence has a positive influence on behavioral intention.	Not supported
H5b	The influence of social influences on behavioral intention is moderated by age.	Not supported
H5c	The influence of social influences on behavioral intention is moderated by gender.	Not supported
H6a	Podcasting has a positive influence on the behavioral intention of adopting m-learning.	Supported
H6b	The influence of podcasting on behavioral intention is moderated by age.	Not supported
H6c	The influence of podcasting on behavioral intention is moderated by gender.	Not supported

of gender, the file was separated into male and female. First, the chi-square and the df for unconstrained model were obtained. Next, the relationships were constrained one at a time and the chi-square vales were then obtained. Table 3 shows that the df difference is 1 for all the models. A p-value of less than 0.05 implies that the chi-square difference is large; hence, the relationship is moderated by gender. In this table, all p-values are more than 0.05. Thus, gender does not have an impact on adopting MTLE.

To investigate the moderated effect on age groups, the data sheet was divided into two age groups. The sample shows 239 students above 21 years old and 112 below 21 years old. The first group was recorded into age less than or equal to 21 years and the next group more than 21 years. It indicates that $p< 0.05$; therefore, no relationship is observed between age group and MTLE adoption.

DISCUSSION

The results demonstrate that performance expectancy is the strongest positive predictor of MTLE adoption. In this study, performance expectancy such as positive feedback toward the interaction between students and educators, as well as the usefulness of the mobile internet for instruction, addresses the value of mtle adoption as scale items. The results coincide with [32,48-50]. All findings reveal that the mobility of mobile technology and its perceived usefulness have significant influences on user intention to employ m-learning.

In the current study, ease-of-learning to use the system refers to the extent to which students believe that using the mobile phone for learning purposes is easy. The results suggest that effort expectancy is not a significant predictor of behavioral intention that influences MTLE adoption. The findings of Wang *et al*. [36] are reinforced by the present results, which indicate that effort expectancy is not a significant predictor of behavioral intention. The results of this study contradict the previous findings in earlier studies, which stated that the perceived ease-of-use and self-efficacy significantly affect behavioral intention [7, 22,51,52]. The present research supports Roberts' [24] statement that "The digital generation never know a world without computers, the World Wide Web, highly interactive video games and cellular phones.". This premise may be due to student familiarity with mobile devices. Social influences, such as classmates, lecturers, faculty support for mobile learning and following trends, were used as scale items in this study. The results imply that social influences are not significant predictors of behavioral intention that influence MTLE adoption. The results contradict the findings of earlier studies [22, 36,53,54]. However, the result of the current study is in line with Williams [28], which stated that social influence is not a significant factor influencing behavioral intention. The current generation is largely dominated by computers, video games and cell phones. Members of this generation have been using such forms of technology as early as eight years old [55]. The influence of their classmates and lecturers is unnecessary. Members of the digital generation are born with technology surrounding them, therefore eliminating the need to be influenced by peers. Facilitating conditions are not significant drivers of behavioral intention that influences MTLE adoption. The result of this study does not coincide with Cheong. [25] Triandis [18] Nasimth and Corlett [55]. However, it supports the findings of the studies of Niehaves *et al*.

[40] and Carlsson *et al*. [53]. According to Niehaves *et al*. [40], facilitating conditions on behavioral intention are not as high as expected. Prensky [1] argued that considering that members of the present generation are born in the age of Technology, they can use gadgets without referring to the user manual.

Affordability is the most significant driver of behavioral intention that influences the behavioral intention of MTLE adoption in this study. The result of this study is similar to the findings of Kuo and Yen [56] and Wang *et al*. [36]. Wagner [54] identified cost to be the significant barrier in the implementation of m-learning. Pagani [31] maintained that cost is the third most important factor considered by customers in choosing mobile services, following ease-of-use and perceived usefulness. The current study reveals that affordability is the most significant driver of behavioral intention that influences MTLE adoption. It also suggests that the cost of the phone and service providers' cost should be reduced to enable students to adopt MTLE.

The result of the current study suggests that pedagogy has a significantly positive influence on the adoption of mobile learning. It supports previous research done by Bell, *et al*. [51], which stated that the participants believe that mobile learning increases the number of hours of studying without removing something from the schedule. The result of the present study also supports the findings of Hoskyns-Long [57], which maintained that podcasts will improve student performance. The current results suggest that podcasting has a positively significant effect on MTLE adoption. Students are evidently confident that podcasting will help them improve their performance.

Age and gender do not have any effect on MTLE adoption. Those between 18 and 24 years belong to the Internet generation, who prefer to explore technology as their learning environment. The study also confirmed that gender has no significant influence on MTLE adoption

Limitations: The scope of the study is limited to private colleges and private universities. In Malaysia generally students from private colleges and universities are economically well off. Thus the results could have limited generalizability.

CONTRIBUTIONS AND CONCLUSION

Rapid development of mobile phone features provides more opportunities to incorporate technology into the learning environment. However, the usage of educational purpose remains limited. This study was conducted to address the above issue. The results are summarized below: Firstly, the study confirmed the strength of UTAUT in predicting MTLE adoption. It validated a new model with two additional constructs of adopting MTLE. This research proved that pedagogy and affordability are the two independent constructs that should be added to the original UTAUT model proposed by Venkatesh *et al*. [16] to fill the gap in the literature review on MTLE adoption. The results contributed several important issues related to the incorporation of MTLE that have not been addressed in previous studies. Hence, the proposed model is a significant contribution to the emerging literature on mobile learning. Secondly, performance expectancy has an effect on student intention to use mobile technology. This finding implied that the performance of mobile technology in relation to instructors (e.g. the delivery of ubiquitous continuous learning) is the most important factor that they consider in the decision to adopt MTLE. This study addressed the benefits of MTLE adoption, such as increased interaction between students and educators, usefulness of mobile Internet for learning purposes and accessibility of information, as scale items. Thirdly, affordability is the most important factor in adopting MTLE. This study is conducted in hopes that the results will encourage service providers to develop marketing strategies for supporting MTLE adoption and eventually increase the number of customers in Malaysia. Universities should focus on how to exploit mobile technology as a tool for accomplishing their educational mission. Our research suggests that universities should engage in new business with service providers to offer affordable charges for the students to use mobile technology. This scenario will encourage MTLE uptake for learning purposes among students. Fourthly, pedagogy is one of the factors that influence MTLE adoption. The responses of students in the study imply that they are interested in accessing learning content through audio and video formats. Therefore, university websites and academics should encourage the use of podcasting. Currently, instructors are considered to be skeptical about the merits of podcasting. Universities should encourage their staff to upload video and audio lectures on their website. The research suggests that the universities should engage in new business with service providers to offer affordable charges for the students, enabling the latter to use mobile technology. This scenario will encourage the students to use mobile technology for learning purposes.

This study provides baseline information on factors that influence the intention behavior of using mobile technology in the learning environment among undergraduates in Malaysia. Increasing diffusion and increasing features in mobile devices extends learning opportunities.As such educational institutes need to incorporate mobile learning in to traditional learning as a supplement.

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