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Understanding the Use of Mobile and Wireless Technology in Higher Education: A Case of Public University Students in Malaysia

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Authors' contributions

This work has been initiated by author FMR on the idea of research and the beginning of writing. The co-author SSSH is the head of the research group who has completed the full writing with the analysis and findings. She also is the respondent and contact person of the paper. Other supporting authors namely CN and Dr NA have collected the data from the surveys and edited the paper.

Original Research Article

ABSTRACT

This study investigated the use of Mobile and Wireless Technology (MWT) in higher education using the selected public university students in Malaysia. A random sampling has been selected among 490 students from three Public Universities and one Polytechnic. The study has been addressed to focus on the applications of MWT in learning and to identify the significant differences between gender and level of studies when using the learning applications via MWT. Using descriptive statistics, Independent t test, Analysis of Variance (ANOVA) and Post Hoc mean comparison test, this study highlighted the low level of MWT usage among students. Among other findings are the differences between gender and level of studies only related to specific learning activities. Implications of the study were discussed.

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1. INTRODUCTION

Mobile technology applications have shown pedagogical potentials for teachers and lecturers to become innovative in teaching. Many adolescents use mobile or wireless based mobile technology (MWT) to communicate and extend their social connectivity. Thus, teachers should use this technology to enhance and attract students toward the new learning environment. Mobile learning or m-learning can be defined as the use of handheld computer devices on which learning can take place across contexts [1]. In the present study, the factors of gender and level of studies among Malaysian Higher learning students have been investigated to determine the use of mobile and wireless technology (MWT) in learning. This study has been designed to focus on the trends among students of Higher Learning. The following research questions have been formulated.

1. *Do students differ significantly on the use of m-learning based on gender?- If so, in which learning context do they differ?'*
2. Do students differ significantly on the use of m-learning based on level of studies? If so, which learning context do they differ?

In the elaborating the contexts, Basaeed, Berry, Jemerly and Benlamri [2] argue that mobile learning varies based on three categories namely: learner, device and connectivity. Firstly, learner relates to personal and learning information. Secondly, device is connected to the attributes and capabilities of the devices ranging from screen resolution, navigation and multimedia capabilities. Thirdly, connectivity relates to communication channels, accessibility of bandwidth, and the cost involved.

Thus, lecturers or teachers need to understand these contexts to ensure that the flexibility of teaching and learning can be reflected in m-learning. However, Prekop and Bennet [3] define contexts into two categories namely: 1) internal dimension which involves human factors such as emotional state, beliefs and previous experiences; and 2) External dimension which involves physical environment such as technological features and device design as well as infrastructure and location. Based on these conceptualizations of contexts in m-learning, the three main factors must involve human elements such as: learners as users and teachers as

learning innovators; types of devices; and Internet connectivity to ensure the success of m-learning.

In previous research of m-learning in Malaysia, Arif, Yasri, Radzi, Husin and Embi [4] have studied the demographic factors namely readiness form-learning. The findings include the importance of the type of devices for the success of m-learning. Atan, Koo, Harji [5] have explored the role of m-learning in Higher Learning contexts. Embi and Nordin [6] have emphasized the importance of education background as a factor for the success of m-learning.

In Western and foreign scenarios, self-regulated learning has been associated with m-learning [7,8]. The studies have gone further to investigate the factors of motivation in learning via mobile technology. This previous research has shown that m-learning can be carried out in Higher Learning institutions through two-way interactions among learners and teachers. Students also learn from their peers. However, this present study further analyzed the factors of demographic in terms of gender and education background in the context of persistent (self-effort) to learn, teacher involvement, and mobile applications for learning. Thus, the focus of the study relates to the general trend in m-learning applications, gender and level of studies involved in the students actual application of m-learning.

2. LITERATURE REVIEW

The previous research on mobile learning has revealed that using mobile technologies such as iPads, tablets, and smart phones which can be carried everywhere confers benefits to the educational environment. Kim, Mims and Holmes [9]'s findings show that mobile technology has academic benefits for students and learners. MWT promotes interest in technology for communication and active learning [10,11,12,13]. Chase and Herro [14]'s finding show that the university students' interest in using mobile wireless technology has increased dramatically. Thus, with the rapid growth of mobile technology and applications, there is a need to study the trend of mobile in learning and to understand the phenomenon of its adoption in higher learning institutions.

Al-Fahad [15,16], and Ruchter, Klar and Geiger [17], have investigated students' perceptions and

attitude in using mobile technology. The findings reveal that students show interest in using wireless mobile technology in learning.

Ally [18] proposes that mobile technology can enrich learning because learning materials are accessible in any place and time. According to Dvorak and Burchanan [19], students have performed with better grades in their exams by utilizing mobile technology in their own learning via MWT. Moreover, students can send their assignments and projects instead of using paper and pen tools [20]. Schepman, Rodway, Beattie and Lambert [21] have investigated the usage of mobile technology in teaching and stated that the majority of students have positive perceptions about mobile learning and students found that mobile learning has helped them to access the information and pedagogical resources quickly. Among students who use mobile technologies in their learning, Martin, Diaz, Sancristobal, Gil, Castro and Peire [22] assert that these students are more engaged in learning compared to students who use traditional learning.

Muhanna [23] has studied the demographic factors such as the level of study and gender of students in a mobile learning environment. The findings show that using mobile technology has triggered more impact on male students compared to female students. The study has also highlighted that undergraduate students are more interested in using mobile learning than postgraduate students.

Wang and Wang [24] carried out a study on the effects of age and gender on using mobile learning. Analysis of the results show that the age and gender differences moderate the impact of social factors in using mobile technology in learning. Thus, the findings are inconsistent in demographic variables such as gender and age in using MWT in learning. More researches need to address the effect of gender, age and level of studies in the context of MWT in higher learning. The findings of this present study will contribute to the body of evidence and enrich the research literature of m-learning.

Students can communicate and interact with others through the mobile and wireless technology application such as short message, Skype, Whatsapp and Viber [25]. Martin et al. [22] assert that some applications such as sharing videos, audios, images and files can easily engage students in the learning process. In an educational setting, students can access learning materials quickly via mobile and wireless technology. The previous literatures have shown that mobile and wireless technology application such as educational games, dictionary, map, calculator, access to Youtube, Twitter and Facebook and course tutorial have high potentials to be taken as platforms for teaching and learning.

3. RESEARCH DESIGN

The present study used a survey method to include the items related to gender, level of studies in the applications of mobile learning and wireless technology. The dimensions to explain m-learning include the effort and persistence to use m-learning and teacher's involvement in using mobile technology. These dimensions were then itemized from 47 questions. Using a researcher-constructed questionnaire, these items have been developed for the purpose of this study. In the data collection, the permission from Higher Ministry of Education and University Academic Affairs were obtained. After approval from the authorities based on the criteria given, students were randomly selected. The survey has been carried out in 3 Public Universities (Undergraduate and postgraduate) and one Polytechnic (Diploma level) in Malaysia. A total of 500 questionnaires were distributed and stratified based on the selected faculties recommended by the authorities and number of population. However, only 490 responded in full and completed the surveys.

Prior analysis procedures included descriptive statistics to provide detailed breakdown of data. Mean and Standard deviations were used to reveal the dispersion of data. These analyses provide some background information before turning to the research focus of the study. Further significant differences were determined using independent t-test (comparing two categories) and ANOVA (comparing more than two categories) to indicate the usage of m-learning among students based on gender and level of studies.

To address the first research question, an independent t-test was used to determine the difference between gender and level of studies. In research question 2, further tests of ANOVA and Post Hoc Tukey analysis were carried out to ensure which context of learning contributes to the significant difference in level of studies.

1. *Do students differ significantly on the use of m-learning based on gender.*
2. Do students differ significantly on the use of m-learning based on level of studies? If so, which learning context do they differ?

The hypotheses were designed as the following:

H_1: Students differ significantly in using mobile and wireless technology based on gender.
H_2: Students differ significantly in using mobile via wireless technology based on level of studies.

4. RESULTS

This study aimed to address the factors of gender and level of studies among Higher learning students in the use of mobile and wireless technology (MWT) in learning. The results are expected to enrich the literature and provide consistent evidence on the influence of demographic in m-learning. Academic uses include the aspect of assessing MWT for teacher feedback, learning resources and information and individual efforts. Thus, the results are provided based on the distributions of data, independent t-test, Analysis Variance Analysis (ANOVA) and a confirmation of result from Post Hoc Tukey analysis.

The breakdown of gender in this study included 270 females and 220 males. Despite the fact that gender comparisons must address equal numbers for valid analysis, the researcher ignored the difference of sample size because the margin was considered small (50 females more than the males).

Table 1 provides background information on the level of agreement according to the items and distributions.

Table 1 reveals descriptive statistics with the dispersion of data (mean and standard deviation). The standard deviation (ranges from1.022 to1.266) indicates that students vary in terms of their responses in the actual use of MWT in learning. The highest mean (M=3.71) reveals on the use of MWT in accessing course assignment. The lowest mean (M=3.43) relates to the comments that students get from their lecturers.

Further inspection of the data from agree and disagree groups, reveals the 67% agreement followed by the lowest 60.1%. It can be suggested that the students use MWT to access their course assignment information from the Learning Management System or other communication tools through Internet.

Table 1. Application in m-learning

	Mean	Std. deviation	%s. agree and strongly agree	%s. disagree and strongly disagree
I get comments about learning from my teacher/lecturer.	3.43	1.266	60.1	22.5
My teacher/lecturer gives me important information for learning.	3.68	1.184	69.6	16.8
I search information for learning purposes.	3.67	1.145	66.8	16.1
I access Youtube videos for learning.	3.59	1.192	63.5	19.6
I exchange learning information with friends.	3.67	1.094	63.5	14.7
I access educational game.	3.60	1.104	60.8	17.8
I access course assignment.	3.71	1.039	67.3	14.9
I access course tutorial.	3.63	1.051	63.3	15.3
I always explore mobile applications to be used in learning.	3.63	1.017	63.5	15.8
I learn English language through dictionary application.	3.61	1.012	63.0	16.0
I write important notes.	3.68	1.022	67.0	13.7
I schedule my learning activities or other application in quick memo/diary.	3.63	1.146	61.0	18.2

Note: Likert scale 1 to 5 (strong disagree to strongly agree with 3 indicates neutral)

Since content management systems become the platform to disseminate learning resources among the Malaysian Universities, it is vital that students use MWT for learning.

Despite the fact that all the mean scores are above the anchor point (>2.5), the distribution of responses based on the level of agreement is considered low (<4.0). More efforts must be taken by the Higher Learning Institutions to include learning materials and student feedback in the Learning Management system or Internet communication tools such as Facebook, Twitter and other social networks. When a teacher communicates and gives feedback to students, the distance among them will reduce and learning becomes effective due to the content structure and planning [26]. Despite Moore's distance education framework, traditional face-to- face learning also involves communications and interactions as to ensure students' involvement. Further, students' ownership and individualized learning should be emphasized in the higher learning Institutions.

To address the research question '*Do students differ significantly on the use of m-learning based on gender*', Table 2 reveals the comparison of means using an independent t-test. The significant mean score difference shows p<0.05

with only three items:- 1) I get comments about learning from my teacher/lecturer (Male= 3.23, F=3.53):- 2) I access You Tube videos for learning (M=3.43,F=3.67):- 3) I always explore mobile applications to be used in learning. The differences of mean scores show that female students use more MWT in getting feedback from lecturers or teachers and getting information from the You Tube. Other usage of MWT in learning shows no difference between males and females.

To determine further on which m-learning context differ among level of studies, Table 3 shows the results of ANOVA and mean comparisons using Tukey test. The findings indicate that only three items of using MWT in learning are different when compared with the level of studies.

It is found that: 1) 'My teacher/lecturer gives me important information for learning: 2) 'I search information for learning purposes': and 3) 'I schedule my learning activities or other application in quick' shows significant differences among levels of studies. Undergraduate students show higher mean scores in the first two items. While diploma- level students show higher mean score in scheduling learning activities using MWT applications.

Table 2. Mean comparison between gender using Independent t test

		Mean	F levene test	Sig at two tailed
I get comments about learning from my teacher/lecturer.	M	3.23	15.168*	**.013***
	F	3.53		
My teacher/lecturer gives me important information for learning.	M	3.67	14.049*	.926
	F	3.68		
I search information for learning purposes.	M	3.64	5.634*	.692
	F	3.68		
I access Youtube videos for learning.	M	3.43	30.296*	**.031***
	F	3.67		
I exchange learning information with friends.	M	3.70	.093	.589
	F	3.65		
I access educational game.	M	3.57	.071	.705
	F	3.61		
I access course assignment.	M	3.75	.308	.543
	F	3.69		
I access course tutorial.	M	3.62	.210	.865
	F	3.63		
I always explore mobile applications to be used in learning.	M	3.80	3.819	**.007***
	F	3.55		
I learn English language through dictionary application.	M	3.67	2.407	.322
I schedule my learning activities or other application in quick memo/diary.	F	3.57	4.718	.864
	M	3.67	20.381	.216

*Note: * significant values of Levene test (p<0.05) indicate variances of sampling from the population based on random sampling. Others indicate similar variances*

Table 3. A summary of results from ANOVA and multiple means comparison

Item	ANOVA p<0.05	Mean comparison between groups p<0.05 using Tukey test	
My teacher/lecturer gives me important information for learning	F=3.241,df=3; P=0.022	Diploma 3.44	Undergraduate 3.82
I search information for learning purposes.	F=2.704;df=3; P=0.045	Diploma 3.43	Undergraduate 3.77
I schedule my learning activities or other application in quick memo/diary.	F=2.736,df=3; 0.043	Diploma 3.81	Post graduate 3.34

The findings of the study indicate that demographic variables play important roles in the study of mobile technology use in learning. Despite the fact that gender equality in technology accessibility and competency are no longer the issues in Malaysia, the attitude among learners in terms of gender must be addressed. Further, the low usage of MWT in learning among students in Higher Institutions is shown. This requires more interventions from the lecturers.

5. DISCUSSION

The study has shown that students in Higher learning use mobile and wireless technology but the usage is still low. When comparing with gender, females show higher usage in relation to feedback given by the lecturers as well as downloading You Tube resources for learning. Other usage related to learning has similar patterns regarding gender. The study provides the information that gender does not show any difference in the usage of mobile technology in learning. Thus, the use of mobile devices in learning depends on the lecturer strategies of learning and communications. However, these findings need to be carefully analyzed before generalizing to other populations. Issues such as which type of mobile devices and wireless accessibility connectivity are essential in influencing the use of m-learning and the findings. In this study, the researchers did not specify which type of mobile technology and assumed that the majority of the students have access to mobile smartphones. In a different country, iPads or tablets may be more common among users at Higher Learning.

In supporting the issue, Chen and Denoyelles [27] reveal that the type of devices will show differences in academic use. They highlight tablets as a potential mobile device to be popularly used in the academic environments. On the other hand, Song, Murphy and Farley [28] have found that the Malaysian Private Higher Learning students have smart phones (60%) when compared with tablets (33%). However, the main intervention is the importance of how the lecturer or teacher structures his contents via Internet applications that allow students to access it using the mobile technology.

The findings of this study, potentially will inform the Ministry of Higher learning about the needs to put more investment on the accessibility of wireless connection in campus. Further, lecturers need to include mobile and wireless technology as part of their learning technology and, customize learning based on the mobile design for example: applications of Learning Management System (LMS) in mobile.

In the context of infrastructure, Internet accessibility is essential for students to use the MWT. Some students rely on wireless technology connected to the University networks. This may hinder them if the Internet connection is not in the vicinity of the University campus. As a recommendation of the study, further effort is needed in purchasing Internet connectivity from other competitive Internet service providers.

Other contribution to the success of MWT learning involves human factor which relates to the teacher as the implementer of the curriculum. A teacher not only organizes the learning content for face- to- face classroom learning, he or she also must include personalized learning where learners take the ownership in the learning process. The students must be involved in finding information [29]; interacting with other students and content [27]: and personalizing learning, where students take ownership in learning [30]. Despite Wood and Price relate MWT learning with patients, it does reflect personalized learning in other contexts as well. More follow ups studies need to be carried out to reveal the effective use of MWT in learning where factors related to teaching strategies, interactions among students and interactions among students and teacher are emphasized.

The gratification of online user in mobile technology must address the web irritation that reduce annoyance of navigation and interface design. [31]. Thus, the success of online learning using mobile technology relies on well designed and effective instructional strategies.

6. CONCLUSION

The findings of the study have extended the literature related to mobile learning and demographic variables. The gender factor plays an important role in realizing the use of mobile learning, but the differences are only in certain contexts. The trend of usage differs in gender only in getting comments, accessing You Tube for learning and explore applications. Females showed more effort as compared to the males in the contexts mentioned. In terms of level of studies, as stipulated in the second research question, the findings indicate that the contexts of: 1) 'My teacher/lecturer gives me important information for learning': 2) 'I search information for learning purposes'; and 3) 'I schedule my learning activities or other application in quick' shows significant difference among levels of studies.

All studies are limited in one way or another: the present study is no different. In particular, there are two major limitations of the current study. First, the data collected was only from public university students. It is recommended that future research collect data from public and private university students because of the possibility of different socio-demographic backgrounds, which may yield potentially different but interesting results. Secondly, this study is very much exploratory and descriptive in nature – that is, it reports only the mean and significance of individual survey items. Thus, future research should consider performing higher level analysis to identify more rigorously the factors that may contribute to a better understanding on the use of mobile and wireless technology in higher education – for example, Lim and Ting [32,33] applied the technology acceptance model and uses and gratifications theory in the e-shopping context in which future research can consider applying these theoretical lenses when investigating the use of mobile and wireless technology in higher education contexts. In short, these identified limitations and future research directions should set the boundaries for interpreting the results from the current study and

stimulate more cross-disciplinary research in the form of information technology and education."

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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