Mid-Pandemic Impact on Mobile Learning Motivation Factors

Neelima Bhatnagar
bhatnagr@pitt.edu
University of Pittsburgh
Greensburg, PA 15601 USA

Ann-Marie Horcher
horcher@northwood.edu
Northwood University
Midland, MI 48642 USA

Abstract

The study examines the motivating factors driving mobile information systems use (MISU) for mobile learning. The primary objectives include comparing attitudes of students and faculty towards the influence of perceived usefulness (PU), perceived playfulness (PP), and perceived enjoyment (PE) on MISU. Additionally, the influence of personal innovativeness (PI) on PU, PE, and PP is also assessed. The previous study examined these attitudes prior to the pandemic. This study focuses on the attitudes existing mid-pandemic, when new strategies toward m-learning were by necessity applied much more broadly than at any other time historically. The method used is a survey of quantitative constructs. Research contributions, limitations, and implications for future research are also discussed. Though student participants felt perceived usefulness led to mobile learning use mid-pandemic, faculty did not. Furthermore, neither group felt perceived usefulness yielded perceived usability.

Keywords: motivation, mobile learning, pandemic, m-learning, COVID-19

1. INTRODUCTION

Organizations of all types have benefited from the development and use of information systems ("Measuring Digital Development Facts and Figures 2021," 2021). With the explosion of mobile applications, also known as mobile information systems, new uses are emerging. One such application of mobile information systems is mobile learning, referred to as m-learning hereafter. M-learning has found its ways in the corporate world for employee training and development, and in higher education for teaching and student learning. However, m-learning has historically not seen the same extent of usage as distance learning and e-learning, often attributed to technological limitations.

Motivational factors, though, may also contribute to the slow adoption of m-learning. But quarantine on a global scale produced a new level of motivation. With schools no longer in person, participation in learning required online interaction. If the problems of m-learning usage are not well understood and addressed, then usage may possibly decrease and the opportunities inherent in m-learning may be missed. Extant literature includes numerous m-learning studies explicitly focused on student use and perceptions of m-learning. Faculty members, on the other hand, have not been the focus of many studies, despite the integral role that faculty motivation likely plays in the use of m-learning. In this study the attitudes of both faculty and student are examined mid-pandemic and compared to a previous study on attitudes pre-pandemic (Bhatnagar, 2019).

2. LITERATURE REVIEW

In the literature several key themes are evident regarding the intersection of the pandemic and the evolution of m-learning. This section discusses those key works, the definitions used in the context of the study, and theories that have previously been used to determine attitudes. The literature points to the validity of the approach and the importance.

The pandemic shaped key trends on usage of the Internet. Though mobile broadband usage was originally expected to peak at 85 percent in 2020, instead now 95 percent has access to a mobile broadband network ("Measuring Digital Development Facts and Figures 2021," 2021). In spite of this coverage, blind spots persist in rural areas. In developing countries, the cost of connecting to mobile broadband remains high, which restricts access.

M-learning mainly involves the use of mobile devices and wireless technologies (Pereira & Rodrigues, 2013) for training, learning, and teaching purposes (Sarrab, Elgamel, & Aldabbas, 2012) and this is the definition that was used in the context of this research study. Eteokleous and Ktoridou (2009) referred to m-learning as a successor of e-learning. They defined e-learning as learning that takes place with the use of digital electronic tools and media. The relationship between these similar concepts is diagrammed by Pereira & Rodriguez (2013) and shown in Figure 1.

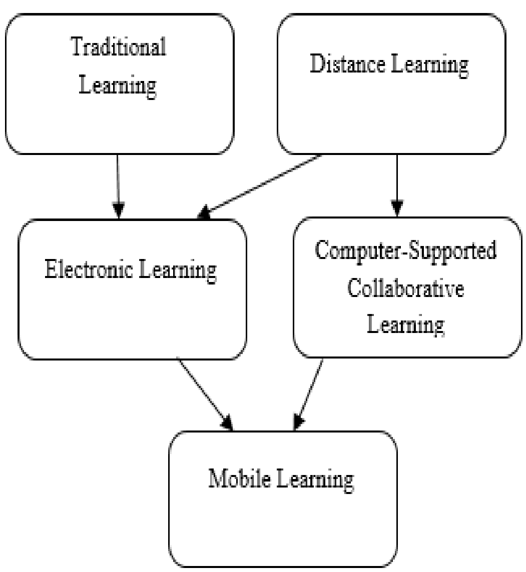

Figure 1: Illustration of the evolution of learning models (Pereira & Rodrigues, 2013)

E-learning moved from being part of the informal education system to mainstream in learning delivery ("78 Essential LMS and eLearning Software Statistics: 2022 Data Analysis & Market Share," 2022). Widespread acceptance of online learning is expected to continue post-pandemic. Cloud-based Learning Management System (LMS) have enabled the rapid adoption of the technology. The millennial population in the workforce is also a driver in the increased use of m-learning tools.

Some studies have started tracking the pandemic's impact on m-learning. In the study of m-learning for medical education, the importance of connecting stakeholders (both students and faculty) and using meaningful interaction with m-learning was exposed (Kalantrion et al., 2022). A study of online learning students in Macao suggests that learning motivation, even in the case of forced adoption of online, is key to success (Zhang, Lam, & Su, 2021). A study of m-learning in the less developed country of Libya points out the importance of good Internet connectivity to acceptance even during the forced adoption caused by the pandemic (Maatuk, Elberkawi, Aljawarneh, Rashaideh, & Alharbi, 2022).

Though the steps for making radical changes in organizations have been previously studied (Cameron & Green, 2019), most organizations did not have the option of controlled change during the pandemic. The typical mitigating actions that would have cushioned the migration to m-learning such as leading communications, satisfying needs for emotional security, etc. (Weiss & Li, 2020) were abbreviated at best. Furthermore, the assault of change was felt not just on learning, but in all aspects of existence.

Various theories have been used to explore attitudes and experiences related to m-learning. The Technology Acceptance Model (TAM) is frequently used in industry and in university settings (Buabeng-Andoh, 2021). The m-learning paradigm has even inspired the Mobile Technology Acceptance Model (MTAM) which adds personal innovativeness and usefulness as constructs driving adoption (Yuan, Tan, Ooi, & Lim, 2021). In a study focused on pedagogy and motivation, a combination of Bloom's taxonomy and Malone and Lepper's Taxonomy of Intrinsic Motivations for Learning was used as the study framework (Troussas, Krouska, & Sgouropoulou, 2022).

Similar to Bhatnagar (2019), perceived usefulness and perceived playfulness has been

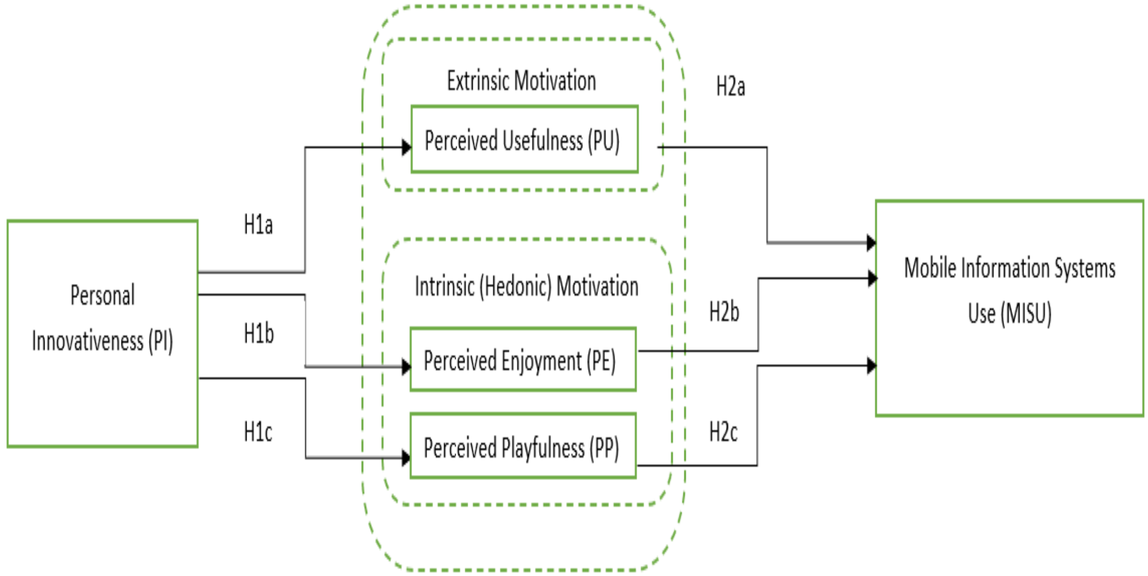

Figure 2: Proposed Theoretical Model adopted from Hwang (2014)

used to explore student acceptance and rejection of the mobile learning apps (Al-Bashayreh, Almajali, Altamimi, Masa'deh, & Al-Okaily, 2022). This study was created very early in the pandemic. It was noted in future directions in Al-Bashayreh et al. (2022) that though pre-pandemic conditions validated the relationships between playfulness and intent to use, the pandemic created an atypical situation where acceptance may have been forced on students.

3. THEORY

As seen in Al-Bashayreh et al. (2022), the influence of both intrinsic and extrinsic motivation factors on mobile information systems use (MISU) was tested. Intrinsic motivation factors assessed included perceived enjoyment (PE) and perceived playfulness (PP). One extrinsic motivator factor was assessed, perceived usefulness (PU). Additionally, the influence of personal innovativeness (PI) on PU, PE, and PP was also assessed.

The central research question that emerged from the current state of m-learning research was how to determine effective use of mobile devices in the context of mobile information system applications such as m-learning. Exploring how to integrate m-learning effectively (Crow, Santos, LeBaron, McFadden, & Osborne, 2010; Lam, Yau, & Cheung, 2010) is an important issue that lacks understanding (Eteokleous & Ktoridou, 2009) and is a major barrier for its use. It is not enough to look only at how mobile devices can be integrated.

Previously Hwang (2014) looked at personal innovativeness as it related to usage of Enterprise Resource Planning (ERP) systems. The factors of PU, PE, and PP were proposed to predict eventual system usage. This model was adapted as shown in Figure 2 to predict Mobile Information Systems Usage (MISU) based on PI, PU, PE, and PP. This lead to the first research question.

RQ1: What are the motivating factors driving m-learning use?

The goal was to examine which if any of the motivating factors of PU, PE, and PP were impacting MISU. Therefore, the following hypotheses were tested using the proposed theoretical model in Figure 2 to answer RQ1.

$H_0$1: PU, PE, and PP positively and significantly influence MISU.
H1a: PI will positively and significantly influence PU.
H1b: PI will positively and significantly influence PE.
H1c: PI will positively and significantly influence PP.

H2a: PU will positively and significantly influence MISU.
H2b: PE will positively and significantly influence MISU.
H2c: PP will positively and significantly influence MISU.

The second research question looks at what is being included in MISU. Particularly in the mid-pandemic timeframe, the range of activities included in m-learning expanded drastically, as did the participating population in comparison to pre-pandemic. This reality incited the second question.

RQ2: How is m-learning being used for teaching, learning, and training?

RQ2 was answered via four questions in the survey instrument. These can be seen in Appendix A & B.

The hypotheses, graphically displayed in Figure 3, were tested using the theoretical model (Figure 2) to answer both research questions via the survey instrument. PI will positively and significantly influence PU, PE, and PP (H1a, H1b, H1c) and PU, PE, and PP will positively and significantly influence MISU (H2a, H2b, and H2c).

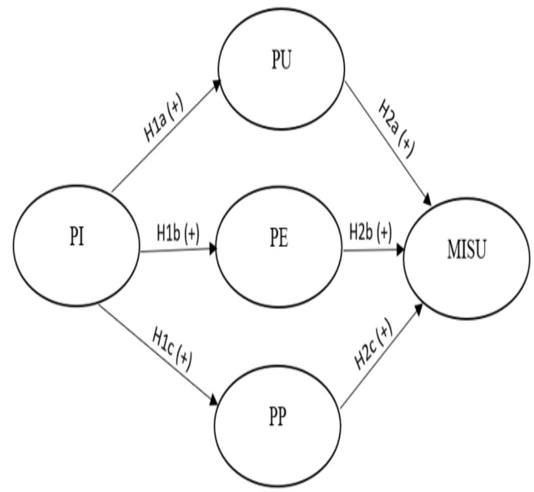

Figure 3: Conceptual Map of the Research Model

4. METHODOLOGY AND PROCEDURE

Institutional Review Board approval was received at the primary investigator's institution prior to commencing the study. An online survey was created using Qualtrics and analyzed using Structural Equation Modeling. The questions replicated those used in a study of pre-pandemic attitudes towards mobile learning (Bhatnagar, 2019). The survey also contained questions to help understand how m-learning is being used for teaching and learning. For details, please see Appendix A (Faculty Survey Instrument) and Appendix B (Student Survey Instrument).
Participants were contacted via email and requested to participate in the study. Whereas the previous study focused only on faculty teaching in the disciplines of computer science, information systems, and business at 60 institutions of higher education (both public and private) who are members of the Association of American Universities (AAU) in the United States, this study was expanded to also include students. Faculty and students at a regional campus of an R1 university in western Pennsylvania along with international students at a European university took the survey. This provides a sample set with wider cultural representation.

The initial email was sent to a total of 959 undergraduate students, 16 graduate students and 186 faculty. A reminder email was sent after one week to 979 undergraduate students and 187 faculty. Additional students had been added to the shared email list in the time since the initial email, so more students were contacted in the reminder. The response rates for both faculty and students were significantly low at 9% and 4% respectively.

The data was first cleaned by removing blank records, and incomplete responses. The data was then coded. Microsoft Excel, SPSS and SmartPLS were used for the data analysis.

In addition to the questions of the original survey (Bhatnagar, 2019), a measurement of usability was also taken using the System Usability Scale (SUS) metric. The importance of student satisfaction during the pandemic forced adoption (Uthman & Ahmed, 2022) seemed to be a critical factor. Usability measures like SUS indicate how users feel about the experience of using the system. Though previous studies of the effect of Computer Anxiety (CA) had not shown a direct relationship between CA and the intention to use (Ball & Levy, 2008), studies during the pandemic have shown otherwise (Alsubaie, Alzarah, & Alhemly, 2022). The amount of change induces technostress which means more attention needs to be paid to the student and faculty experience.

The reliability and validity of SUS has been documented by 20 years of SUS Scores (Sauro, 2011). Reliability refers to the consistent response to the items. SUS detects differences in smaller sample sizes (as few as two users) and generates reliable results. Validity refers to whether an instrument measures the target, which for SUS is perceived usability. SUS has been shown to effectively distinguish between unusable and usable systems and correlates highly with other questionnaire-based measurements of usability. These characteristics combine to make SUS an improvement to commercial alternatives and home-grown questionnaires (Sauro, 2011). The SUS provides a comprehensive measure in addition to the dimensionality measures of the original instrument.

The discussion of key results is divided into two sections. The first section provides a comparison of the results between the pre-pandemic and mid-pandemic findings. The second section looks at the student data results.

5. COMPARISON PRE/MID PANDEMIC RESULTS FOR FACULTY

SPSS was used to perform pre-analysis data screening. Outliers, or extreme cases, in the data were evaluated for all datasets using both the univariate and multivariate techniques. Since the data was coded on a 7-point Likert scale, a visual inspection of the data showed no univariate outliers. With 24 items, the degrees of freedom is 24 and the critical value for chi-square at $p<.001$ equals 51.179. For the current study, the analysis called for the elimination of one case, but it was not removed. In the pre-pandemic study six cases had to be removed since the Mahalanobis distance was greater than 51.179.

Structural model analysis was done in two parts. The measurement model focuses on internal consistency reliability, convergent validity, and discriminant validity. The structural model is assessed by evaluating collinearity, the significance of path coefficients, the level of R^2 values, the f^2 effect size, the predictive relevance (Q^2), and the q^2 effect size (Hair Jr, Hult, Ringle, & Sarstedt, 2013).

Measurement Model

Internal consistency reliability is measured by evaluating composite reliability and Cronbach's alpha. Composite reliability ranges between zero and one. The higher the number, the higher the composite reliability. Cronbach's alpha greater than 0.8 are good. The model showed strong internal consistency reliability for both the pre-pandemic and mid-pandemic studies.

The two most common measures of construct validity are convergent and discriminant validity. Any reflective indicator whose outer loading is below 0.4 should be removed. However, indicators with outer loadings between 0.4 and 0.7 should be further analyzed by looking at the impact on composite reliability and average variance extracted (AVE) before any elimination takes place (Hair Jr et al., 2013).

In the pre-pandemic study, MISU7 had an outer loading of -0.358, in this study it is 0.044. Since

Model	Pre-Pandemic	Mid-Pandemic
Measurement	Strong internal consistency reliability	Strong internal consistency reliability
	Convergent validity achieved after removing MISU7, PP1, and PP2	Convergent validity achieved after removing MISU7, PP1, and PP2
	Discriminant validity was achieved	Discriminant validity was achieved
Structural	No collinearity issues were found	No collinearity issues were found
	All paths except H2c were positive	All paths except H2c were positive
	H2b and H2c were rejected as they were not significant	H2a, H2b, and H2c were rejected as they were not significant
	R^2 values showed weak predictive accuracy	PI did not appear in the results, R^2 values for remaining constructs show moderate predictive accuracy
	Effect size (f^2) was small for H1a and H2a, medium for H1c, and large for H1b	Effect size (f^2) was small for H2c, medium for H2a and H2b, and large for H1a, H1b, and H1c
	Q^2 values indicated model has minimal predictive relevance	Q^2 values indicated model has a strong predictive relevance
	q^2 effect size very small for PE, PU, and PP.	q^2 effect size medium for PE and PU and small for PP

Table 1: Comparative Analysis of Results for Faculty

it is below 0.4, it should be removed. PP1 and PP2 have outer loadings between 0.4-0.7, 0.681 and 0.697 respectively (in the previous study with 0.641 and 0.495 respectively). These were further examined by looking at the impact on composite reliability and average variance extracted (AVE) before their elimination. As was the case in the previous study, composite reliability, Cronbach's alpha, and AVE are greatly improved by removing MISU7, PP1, and PP2. These three indicators were removed prior to completing the remainder of the analysis. The indicator reliability is the squared value of an indicator's outer loading.

Discriminant validity is assessed by examining the indicator cross loadings and the Fornell-Larcker criterion. In both studies these were met without any issues.

Structural Model

The structural model is assessed by evaluating collinearity, the significance of path coefficients, the level of R^2 values, the f^2 effect size, the predictive relevance (Q^2), and the q^2 effect size (Hair et al., 2013). These are discussed next.

SPSS was used to assess collinearity. Collinearity involves examining tolerance levels and the variance inflation factor (VIF). Tolerance levels below 0.2 and VIF above 5.0 are indicators of collinearity. In both studies the results indicate no collinearity issues.

Structural model path coefficients should be between -1 and +1. Coefficients that are close to +1 represent a strong positive relationship, -1 a strong negative relationship, and close to zero a weak or nonsignificant relationship (Hair et al., 2013). Since the hypotheses for the study are unidirectional, this implies a one-tailed test. In the pre-pandemic study, two of the paths were not significant, from PE to MISU (rejecting H2b) and from PP to MISU (rejecting H2c). In this study besides these two, the path from PP to MISU is also not significant (rejecting H2a).

The coefficient of determination, R^2, value ranges from 0 to 1 and there is no agreed upon value for an acceptable R^2 value (Hair et al., 2013). However, Hair et al. stated that values of 0.75 (substantial), 0.50 (moderate), and 0.25 (weak) can be used as a rule of thumb. Based on the results, MISU, PE, PI, and PP had weak predictive accuracy in the pre-pandemic study. In this study, PI did not appear in the results and the remaining constructs have a moderate predictive accuracy.

According to Hair et al. (2013), effect size (f^2) values of 0.02 (small), 0.15 (medium), and 0.35 (large) are the effect sizes that should be used to evaluate the structural model. In the previous study, PI had a large effect on PE, a medium effect on PP. and a small effect on PU and PU had a small effect on MISU. In this study, PI has a large effect on PU, PE, and PP whereas PU and PE have medium effects on MISU and PP has a small effect on MISU.

Blindfolding is a method used to calculate predictive relevance (Q^2). Q^2 indicates the model's predictive relevance (Hair Jr et al., 2013). Assessment of Q^2 uses the same values for small, medium, and large as f^2. While the pre-pandemic study showed the model to have some predictive relevance, even if minimal, in the current study the model has a stronger predictive relevance.

Just as f^2 effect size is used to assess R^2 values, relative impact of predictive relevance can be compared by means of the measure to the q^2 effect size (Hair Jr et al., 2013). The equation to calculate the q^2 effect is seen below.

$(Q^2 \text{ included} - Q^2 \text{ excluded}) / (1 - Q^2 \text{ included})$

The values of 0.02, 0.15, and 0.35 show small, medium, or large predictive relevance. MISU is the endogenous variable. By removing each of the latent variables (PE, PU, and PI) one at a time, and calculating the predictive relevance, determines the effect size of each latent variable on the endogenous variable. In the previous study it was determined that all predictor variables had a very small effect size. In this study, PE and PU have a medium effect size while PP has a small effect size. Table 1 summarizes the

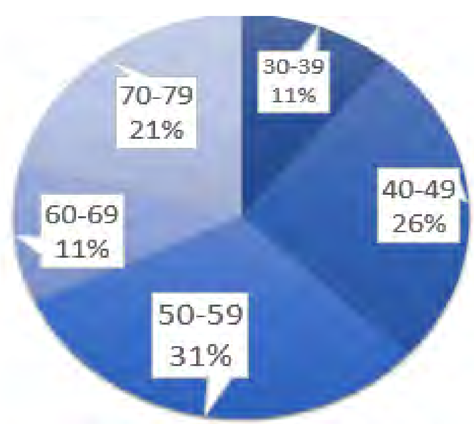

Figure 4: Faculty age range

findings of the mid- and pre-pandemic data results for faculty.

Faculty Demographics

In the current study, analysis of the faculty demographics showed that the survey was completed primarily by females (56%) in the age ranges shown in Figure 4. Overwhelmingly 81% have earned doctorate degrees and teach in disciplines other than Information Systems, Business, and Computer Science. The disciplines in which participants obtained their higher degree was wide ranging. All participants (100%) teach at the undergraduate level. It was interesting to find that 31% of them teach on-campus (i.e. in-person, face-to-face) and hybrid in spite of the pandemic.

The average number of years of teaching experience is 22 years and the average number of years in higher education is 20 years. A majority are employed full-time (75%) and teach at a public university (94%). The average years of teaching on-campus are 19, online 5, and hybrid 3. Most are not on tenure track (62%).

Pre-Pandemic M-Learning Uses

The uses of m-learning (which address RQ2) showed that 18% of the participants using m-learning (n=87) used four of the five options provided: in-class and out-of-class activities, online and hybrid course. Around 8% used one or more combinations of the options provided. The types of activities being used for m-learning in teaching were wide ranging. See Appendix C for the types of activities surveyed.

Of the 87 participants who identified themselves as users of m-learning, three (3%) stated that they had been using m-learning for less than one year, 55 (63%) started using m-learning between 1 to 6 years ago, seven (8%) between 7 to 10 years, and 22 (25%) had started using it over ten years ago. Seventy-six (87%) use it anywhere from several times a day to 3-5 days a week. The remaining 11 participants (or 12%) use it less frequently. Sixty-three (72%) of the 87 participants stated that they felt moderately or very comfortable using m-learning.

Teaching resources provided on a mobile device resulted in 61 combinations of choices. The top three choices accounted for 17% of the resources used. These include using a combination of lecture PPT slides, audio, and video recordings, print content, eBooks, hyperlinks to course-related reference material, and Blackboard. Some participants also provided information on other resources provided to students on a mobile device. The most commonly listed system was Canvas.

In general, most participants (86%) expressed a level of satisfaction in using m-learning that ranged between somewhat to mostly satisfied. Hardware used for m-learning primarily includes generic laptops, phones, video cameras, computers, and e-readers. Next would be all the Apple products (iPhone, iPad, mac, MacBook). The predominant software used is Canvas. Others used are wide-ranging (Bhatnagar, 2019).

Mid-Pandemic M-Learning Uses

Faculty are currently using m-learning for all of the following options (in various types of combinations): in-class and out-of-class activities, online course, hybrid course, as well as for professional development/training. All 16 participants started using m-learning over a year ago, eleven (70%) have been using it between 1 to 6 years, two (12%) have been using it between 7 to 10 years, and the remaining three (18%) have been using it over 10 years. Sixty-two percent use it anywhere from several times a day to about once a day. Twenty-five percent use it 3-5 days a week, twelve percent use it 1-2 days a week, twelve percent use it every few weeks or less often, and only six percent has never used it. Two new questions were added to the survey. The first asked if participants were given a choice other than mobile learning during the pandemic. Thirty-seven percent said yes, and sixty-three percent said no.

Of those that stated they were not given a choice, all participants stated that they did not choose to not teach to avoid mandatory mobile learning. Almost seventy percent stated they are moderately or very comfortable in using m-learning. Teaching resources provided on a mobile device resulted in 14 combinations from the choices that were provided. Some of these choices included lecture PPT slides, audio, and video recordings, among others. A majority (87.5%) expressed a level of satisfaction ranging from neither satisfied nor dissatisfied to somewhat satisfied. Participants were asked to identify how frequently they engaged in various types of activities using their mobile devices to support teaching. See Appendix C for a breakdown of the responses. In a follow-up question most participants (68%) said they did not engage in any other activities using mobile devices to support teaching.

Hardware used for m-learning primarily includes phones and laptops. Canvas is the learning management system used at the regional campus where the survey was administered and chosen by majority of the participants. There were a myriad of other software programs identified, some discipline specific.

6. MID-PANDEMIC STUDENT RESULTS

As discussed earlier, students were added to the study for the mid-pandemic study. In the conditions of the mid-pandemic, it was felt student results, though not part of the previous study, were also relevant. This section analyzes the student data.

Measurement Model

There were no outlier cases with a value greater than 51.179 that had to be eliminated. The model showed strong internal consistency reliability for all constructs except PP. Convergent validity analysis showed the outer loadings for PP1 between 0.4 and 0.7 and below 0.4 for MISU7 and PP2. As such composite reliability, Cronbach's alpha, and AVE greatly improve by removing MISU7, PP1, and PP2. These indicators were removed before proceeding the remainder of the analysis. Indicator cross loadings and the Fornell-Larcker criterion were met without any issues indicating no issues with discriminant validity.

Structural Model

Analysis of the constructs showed collinearity issues with PP in terms of tolerance and VIF. Based on the structural model and path coefficients, two of the paths were not significant, from PI to PE (rejecting H1b) and from PP to MISU (rejecting H2c). The coefficient of determination (R^2) values for PE, PI, and PP indicate weak predictive accuracy. In terms of effect size (f^2), PU and PE have a large effect on MISU, PI has a medium effect on PE, PU, and PP, and PP has a small effect on MISU. Blindfolding and predictive relevance (Q^2) showed that the model does have predictive relevance. Effect size (q^2) indicates that all predictor variables have a medium to large effect size.

Student Demographics

Analysis of the student demographics questions shows that the average age of the participants is 20 years old. The survey was completed by more females (48%) than males (46%). A majority of the students were undergraduates (78%) and 19% were graduate students. The graduate students were primarily pursuing business degrees while the undergraduate students represented a variety of disciplines such as business, management, biological sciences, information technology/cybersecurity, nursing, psychology, among others. Some of the disciplines were listed as double majors.

7. DISCUSSION

Several important conclusions emerge from the analysis. The results of the study related to the hypotheses are shown in Table 2.

Hypotheses	Construct	Pre	Mid
H1a	PI → PU	Accept	Accept
H1b	PI → PE	Accept	Accept
H1c	PI → PP	Accept	Accept
H2a	PU → MISU	Accept	***Reject***
H2b	PE → MISU	Reject	Reject
H2c	PP → MISU	Reject	Reject

Table 2: Summary of Hypotheses (Faculty)

Pre/Mid Pandemic (Faculty)

In both the pre-pandemic and the current study, PI did positively and significantly influence PU, PE, and PP. This led to accepting H1a, H1b, and H1c. Hwang's (2014) research had explored testing the impact of personal innovativeness of IT (PIIT) on the intrinsic motivation factors perceived enjoyment (PE) and perceived ease of use (PEOU) and the extrinsic motivation factor of perceived usefulness (PU) as it related to the use of ERP systems. Hwang arrived at similar conclusions with PIIT influencing PE, PEOU, and PU. In the context of both studies, the fact that PI positively and significantly influences PE, PU, and PP implies that the participants are willing to try using new technologies, such as mobile information systems, because they find these systems to be useful, enjoyable, and like interacting with these.

Also in the pre-pandemic study, PU was found to positively influence MISU, but this is not the case for the mid-pandemic study. Prior to the pandemic, this implied that participants are using mobile information systems (m-learning) because they find m-learning to be useful for teaching and student learning. Even earlier studies of the impact of PU on IS continuance intention using Blackberry hardware showed PU positively impacted IS use (Chen, Meservy, & Gillenson, 2012).

For the mid-pandemic, in spite of perceived usefulness, the participants did not find that a motivator for MISU.
Third, in the previous study, PE and PP did not influence MISU which meant that using mobile

information systems for m-learning was not perceived to be enjoyable or interesting to use or that enjoyment and playfulness were not the reasons that would influence using mobile information systems, such as m-learning. This is also true for the current study.

Fourth, based on R^2 and Q^2 values, the model has a weak predictive accuracy and minimal predictive relevance, whereas in the current study, the model shows moderate predictive accuracy and a strong predictive relevance.

Fifth, in the pre-pandemic study, the f^2 of PE and PP has no effect on MISU, which also confirmed the rejection of H2b and H2c while the other effect sizes confirm accepting H1a, H1b, H1c, and H2a. In the current study, there were no f^2 values which had no effect on MISU even though the structural paths indicate that H2a, H2b and H2c should be rejected.

Lastly, in the previous study the q^2 effect size showed little to no significance for PE, PU, and PP while in the current study the significance is small for PP and medium for PE and PU.

Mid-Pandemic (Student)

As seen in Table 3, the student results matched the faculty response for H1a, H1c and H2c. The effect of PI on PE was rejected by the students (H1b). Unlike the faculty in the mid-pandemic result, the effect of PU and PE on MISU were accepted.

Hypotheses	Construct	Result
H1a	PI → PU	Accept
H1b	PI → PE	Reject
H1c	PI → PP	Accept
H2a	PU → MISU	Accept
H2b	PE → MISU	Accept
H2c	PP → MISU	Reject

Table 3: Summary of Hypotheses (Student)

The students do feel enjoyment will encourage MISU. But they do not feel that playfulness will encourage MISU. Considering that these results were obtained in a time period where adoption of MISU was mandatory due to the pandemic, students may be expressing a frustration with the lack of options.

SUS

Examining the SUS data from both the faculty and student revealed the perception of a lack of usability in the m-learning applications. Analysis of the SUS data typically yields a letter grade of A-F. The participants rated the usability of m-learning at a solid D, or barely acceptable.

This finding is interesting, in light of the contrast between student and faculty results for perceived enjoyment. Student results did support that PE positively influenced MISU. Faculty results did not. But neither rated the usability of m-learning favorably. Once again, this points to the technostress induced by the intense and rapid implementation due to COVID-19 (Uthman & Ahmed, 2022). The stress on both faculty and students did not make them feel m-learning systems were usable.

In addition, the 81% of the faculty participants were not teaching the more technological subjects of Information Systems, Computer Science, or Business. The low usability score may also be affected by lesser expertise in technology.

8. CONTRIBUTIONS, LIMITATIONS, AND FUTURE RESEARCH

Contributions

The results achieved from the study are valuable and provide significant contributions to the body of knowledge. The research helped 1) identity motivation factors driving the use of mobile information systems for m-learning, 2) understand how m-learning is being used for teaching, learning, and training. The research extends prior research on m-learning which has been deficient in understanding faculty use of m-learning.

No prior research studies were found that looked at motivation factors for the use of m-learning and were limited on understanding faculty use with most research focused on student use. Research on information systems use is ample but research focusing on mobile information systems use is limited or nonexistent. Finally, research on motivation to use m-learning during forced adoption due to a global health crisis is non-existent. This is the unique contribution of this research to the fields of Human Computer Interaction/User Experience (HCI/UX), Information Systems, and M-learning.

Limitations

Limitations of both the pre-pandemic and mid-pandemic studies include the limited participants who were contacted to participate in the study, affecting the generalizability of the studies. The mid-pandemic study had a specific window of time to gather results before conditions shifted again. Additionally, the low response rate and self-reporting by participants completing an online survey may have introduced bias in the responses received.

Future Research

Given the limited scope of the study, it is evident that more research is needed. It should also be expanded to include more institutions of higher education and additional disciplines. Non-response rate and the generalizability of the study must also be accounted for. Grounding the study in other information systems theories that may better explain use or non-use is also suggested. This would allow investigating other factors beyond PI, PU, PE, and PP, such as resistance to use. Finally, as suggested by Ball and Levy (2008), research on methods to encourage instructors in the use of emerging technology would benefit both the researchers and practitioners. Such research could address the technostress (Uthman & Ahmed, 2022) experienced by both students and instructors.

It is hoped the results of this study may be compared to future research that repeats these questions in a post-pandemic world. In the future study the constructs PP1, PP2, and MISU7 (as seen in Figure 1) should not be included because composite reliability, Cronbach's alpha, and AVE are improved when they are removed. Further comparison of the data to a reality without forced adoption may reveal insights on motivations. The forced adoption may be a key factor in motivation and user satisfaction.

9. CONCLUSION

The data for motivating factors shows some differences between faculty and student attitudes towards m-learning. Some shift in perception is also shown based on pre-pandemic to mid-pandemic. As the situations surrounding the implementation of m-learning continue to shift, it will be of interest to see how this influences the attitudes of faculty and student. Information System (IS) educators should be aware of the negative attitudes towards perceived usefulness and perceived usability of m-learning systems.

10. ACKNOWLEDGEMENTS

The portion of this research that took place at a European university was supported by the U.S scholar program through the Fulbright commission. The authors would also like to thank the participants for providing data in a timely manner to allow analysis at this unique point in m-learning usage.

11. REFERENCES

78 Essential LMS and eLearning Software Statistics: 2022 Data Analysis & Market Share. (2022). Retrieved from https://financesonline.com/lms-and-elearning-software-statistics/

Al-Bashayreh, M., Almajali, D., Altamimi, A., Masa'deh, R. e., & Al-Okaily, M. (2022). An empirical investigation of reasons influencing student acceptance and rejection of mobile learning apps usage. *Sustainability, 14*(7), 4325.

Alsubaie, M. A., Alzarah, L. N., & Alhemly, F. A. (2022). Faculty Members' Attitudes and Practices: How They Responded to Forced Adoption of Distance Education? *SAGE Open, 12*(3), 21582440221108165. doi:10.1177/21582440221108165

Ball, D. M., & Levy, Y. (2008). Emerging educational technology: Assessing the factors that influence instructors' acceptance in information systems and other classrooms. *Journal of Information Systems Education, 19*(4), 431.

Bhatnagar, N. (2019). *Motivation Factors for Using Mobile Information Systems in M-Learning.* Nova Southeastern University.

Buabeng-Andoh, C. (2021). Exploring University students' intention to use mobile learning: A research model approach. *Education and Information Technologies, 26*(1), 241−256. doi:10.1007/s10639-020-10267-4

Cameron, E., & Green, M. (2019). *Making sense of change management: A complete guide to the models, tools and techniques of organizational change*: Kogan Page Publishers.

Chen, L., Meservy, T. O., & Gillenson, M. (2012). Understanding information systems continuance for information-oriented mobile applications. *Communications of the Association for Information Systems, 30*(1), 9.

Crow, R., Santos, L. M., LeBaron, J., McFadden, A. T., & Osborne, C. F. (2010). Switching gears: moving from e-learning to m-learning. *MERLOT Journal of Online Learning and Teaching, 6*(1), 268-278.

Eteokleous, N., & Ktoridou, D. (2009). Investigating mobile devices integration in higher education in Cyprus: Faculty perspectives. *International Journal of Interactive Mobile Technologies, 3*(1).

Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2013). *A primer on partial least squares structural equation modeling (PLS-SEM)*: Sage publications.

Hwang, Y. (2014). User experience and personal innovativeness: An empirical study on the enterprise resource planning systems. Computers in Human Behavior, 34, 227-234. doi:10.1016/j.chb.2014.02.002

Kalantrion, M., Sadoughi, M.-M., Ahmady, S., Kallestrup, P., Katibeh, M., & Khajeali, N. (2022). Introducing a mobile learning model in medical education during COVID-19; a critical review. *Journal of Advances in Medical Education & Professionalism, 10*(3), 145-155.

Lam, J., Yau, J., & Cheung, S. K. (2010). *A review of mobile learning in the mobile age.* Paper presented at the International Conference on Hybrid Learning.

Maatuk, A. M., Elberkawi, E. K., Aljawarneh, S., Rashaideh, H., & Alharbi, H. (2022). The COVID-19 pandemic and E-learning: challenges and opportunities from the perspective of students and instructors. *Journal of Computing in Higher Education, 34*(1), 21-38.

Measuring Digital Development Facts and Figures 2021. (2021). Retrieved from https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2021.pdf

Pereira, O. R., & Rodrigues, J. J. (2013). Survey and analysis of current mobile learning applications and technologies. *ACM Computing Surveys (CSUR), 46*(2), 1-35.

Sarrab, M., Elgamel, L., & Aldabbas, H. (2012). Mobile learning (m-learning) and educational environments. International Journal of Distributed & Parallel Systems, 3(4), 31-38. doi:10.5121/ijdps.2012.3404

Sauro, J. (2011). Measuring usability with the system usability scale (SUS).

Troussas, C., Krouska, A., & Sgouropoulou, C. (2022). Enriching Mobile Learning Software with Interactive Activities and Motivational Feedback for Advancing Users’ High-Level Cognitive Skills. *Computers, 11*(2), 18.

Uthman, A., & Ahmed, A. (2022). Students' Perceptions of the Actual Use of Mobile Learning during COVID-19 Pandemic in Higher Education. *Sustainability (Basel, Switzerland), 14*(3), 1125. doi:10.3390/su14031125

Weiss, P. G., & Li, S.-T. T. (2020). Leading Change to Address the Needs and Well-Being of Trainees During the COVID-19 Pandemic. *Academic Pediatrics, 20*(6), 735-741. doi:https://doi.org/10.1016/j.acap.2020.06.001

Yuan, Y.-P., Tan, G. W.-H., Ooi, K.-B., & Lim, W.-L. (2021). Can COVID-19 pandemic influence experience response in mobile learning? *Telematics and Informatics, 64*, 101676.

Zhang, H., Lam, J. F. I., & Su, S. (2021). *A Qualitative Research on the Online Learning Experiences of College Students in Macao during the Pandemic*. Paper presented at the 2021 5th International Conference on Education and E-Learning, Virtual Event, Japan. https://dl.acm.org/doi/10.1145/3502434.3502470

APPENDIX A
Faculty Survey Instrument

1 Which of the following best describes YOUR use of m-learning at your current institution? Please check all that apply.
For in-class activities
For out-of-class activities
For an online course
For a hybrid course (combination of in-class and online)
For professional development/training

Scale for items 2 through 6:

[1] strongly disagree, [2] disagree, [3] strongly disagree, [4] neither agree or disagree, [5] slightly agree, [6] agree, [7] strongly agree

2 Personal Innovativeness (PI) - "willingness of an individual to try out any new information technology." (Agarwal & Prasad, 1998, p. 260)
PI1. If I hear about new information technology, I will look for ways to experiment with it.
PI2. Among my faculty peers, I am usually the first to try out new information technologies.
PI3. In general, I am not hesitant to try out new information technologies.
PI4. I like to experiment with new information technologies.

3 Perceived Usefulness (PU) - "degree to which a person believes that using a particular system would enhance his or her job performance." (Davis, 1989, p. 320)
PU1. Using m-learning makes it easier to teach.
PU2. Using m-learning enhances my teaching effectiveness.
PU3. Using m-learning gives me greater control over teaching.
PU4. I find m-learning to be useful in my teaching.

4 Perceived Enjoyment (PE) - "extent to which the activity of using the computer is perceived to be enjoyable in it's own right, apart from any performance consequences, that may be anticipated." (Davis et al., 1992, p. 1113)
PE1. Using m-learning is fun.
PE2. Using m-learning is enjoyable.
PE3. Using m-learning is very entertaining (pleasant).
PE4. Using m-learning is interesting.

5 Perceived Playfulness (PP) - "the extent to which the individual finds the interaction intrinsically enjoyable or interesting." (Moon & Kim, 2001, p. 219)

PP1. When using m-learning, I will not realize the time elapsed.
PP2. When using m-learning, I will forget the work I must do.
PP3. Using m-learning will give enjoyment to me for my teaching.
PP4. Using m-learning will stimulate my curiosity.
PP5. Using m-learning will lead to my exploration.

6 Mobile Information System Use (MISU) - involves the use of mobile devices to use an information system to "...carry out tasks and activities on the job for which the information system is designed to support" (Sun & Teng, 2012). Examples would include using learning management systems such as Blackboard and Banner.
MISU1. I use mobile information systems on a regular basis.
MISU2. I will continue to use mobile information system in the future.
MISU3. I intend to continue using mobile information systems.
MISU4. I want to continue using mobile information systems rather than discontinue.
MISU5. I predict I will continue using mobile information systems.
MISU6. I plan to continue using mobile information systems.
MISU7. I will stop using mobile information systems in the future.

7 Rate each of the following statements:

[1] strongly disagree, [2] disagree, [3] neither agree or disagree, [4] agree, [5] strongly agree

I think that I would like to use mobile learning frequently.
I found mobile learning to be simple.
I thought mobile learning was easy to use.
I think that I could use mobile learning without the support of a technical person.
I found the various functions in mobile learning were well integrated.
I thought there was a lot of consistency in mobile learning.
I would image that most people would learn to use mobile learning very quickly.
I found mobile learning very intuitive.
I felt very confident using mobile learning.
I could use mobile learning without having to learn anything new.

8 How long ago did YOU start using m-learning?
Less than 1 year
1-2 years
3-4 years
5-6 years
7-8 years
9-10 years
More than 10 years

9 How often do YOU use m-learning? Please check all that apply.
Several times a day
About once a day)
3-5 days a week
1-2 days a week
Every few weeks
Less often
Never

10 Were you given a choice other than mobile learning during the pandemic?
Yes
No

11 Did you choose to not teach to avoid mandatory mobile learning?
Yes
No

12 What is your level of comfort in using m-learning?
Very uncomfortable
Moderately uncomfortable
Slightly uncomfortable
Neutral
Slightly comfortable
Moderately comfortable
Very comfortable

13 Which of the following teaching resources do YOU provide on a mobile device? Select all that apply.
Lecture PPT slides
Audio recordings (e.g. recordings of lectures, school information)
Videos (e.g. course-related, recordings of lectures, school information)
Print content
Ebooks
Flashcards and other interactive educational games
Hyperlinks to course-related reference material
Blackboard
Other: please specify

14 Rate your level of satisfaction with the use of m-learning.

Completely dissatisfied
Mostly dissatisfied
Somewhat dissatisfied
Neither satisfied or dissatisfied
Somewhat satisfied
Mostly satisfied

Completely satisfied

15 How frequently do you engage in the following activities using your mobile device(s) to support teaching?
[1] Never, [2] Rarely, [3] Occasionally, [4] Sometimes, [5] Frequently, [6] Usually, [7] Always

Emailing students
Emailing colleagues
Texting students
Texting colleagues
Posting grades
Posting to discussion boards
Accessing course site
Accessing library resources
Accessing social networking
Ordering textbooks
Searching the internet
Providing tutoring services
Preparing lessons
Conducting seminars
Collecting content for coursework
Reading ebooks
Taking pictures or making videos to include in your courses

As a follow-up to the previous question, do you engage in any other activities using your mobile device(s) to support teaching?

Yes, please specify:
No

16 What technologies do you use for m-learning (hardware, software)?

17 To which gender identify do you most identify?
Male
Female
Transgender female
Transgender male
Gender variant/non-conforming
Not listed
Prefer not to answer

18 Please indicate your age group
20-29
30-39
40-49
50-59
60-69
70-79
80 and over

19 Your number of years of teaching experience:

20 Your number of years in higher education:

21 Your academic rank
Lecturer
Instructor
Assistant Professor
Associate Professor
Professor
Emeritus
Other: please specify

22 Please indicate highest education level achieved.
Master's
Doctorate
Professional degree: please specify:
Other: please specify

23 Please indicate the discipline in which you obtained your highest degree:

24 Please indicate your program area/discipline in which you are currently teaching:
Information Systems
Business: please specify
Other:

25 What college level are you teaching?
Undergraduate
Graduate
Both undergraduate and graduate

26 Do you teach courses for students? Select all that apply.
On-campus (in-person, face-to-face)
Off-campus (purely online)
Hybrid (on-campus and online)

27 How long have you been teaching on campus? (i.e. in-person, face-to-face) courses?

28 How long have you been teaching online courses?

29 How long have you been teaching hybrid courses?

30 Do you teach full-time or part-time?
Full-time
Part-time

31 Please indicate the type of university you are currently affiliated with.
Public
Private

32 What is your tenure status?
Currently hold tenure at this institution
Currently on tenure-track at this institution
Not on tenure-track at this institution
Tenure is not available at this institution

APPENDIX B
Student Survey Instrument

Scale for items 1 through 5:

[1] strongly disagree, [2] disagree, [3] strongly disagree, [4] neither agree or disagree, [5] slightly agree, [6] agree, [7] strongly agree

1 Personal Innovativeness (PI) - "willingness of an individual to try out any new information technology." (Agarwal & Prasad, 1998, p. 260)

PI1. If I hear about new information technology, I will look for ways to experiment with it.
PI2. Among my student peers, I am usually the first to try out new information technologies.
PI3. In general, I am not hesitant to try out new information technologies.
PI4. I like to experiment with new information technologies.

2 Perceived Usefulness (PU) - "degree to which a person believes that using a particular system would enhance his or her job performance." (Davis, 1989, p. 320)

PU1. Using m-learning makes it easier to learn.
PU2. Using m-learning enhances my learning effectiveness.
PU3. Using m-learning gives me greater control over learning.
PU4. I find m-learning to be useful in my learning.

3 Perceived Enjoyment (PE) - "extent to which the activity of using the computer is perceived to be enjoyable in it's own right, apart from any performance consequences, that may be anticipated." (Davis et al., 1992, p. 1113)
PE1. Using m-learning is fun.
PE2. Using m-learning is enjoyable.
PE3. Using m-learning is very entertaining (pleasant).
PE4. Using m-learning is interesting.

4 Perceived Playfulness (PP) - "the extent to which the individual finds the interaction intrinsically enjoyable or interesting." (Moon & Kim, 2001, p. 219)
PP1. When using m-learning, I will not realize the time elapsed.
PP2. When using m-learning, I will forget the work I must do.
PP3. Using m-learning will give enjoyment to me for my learning.
PP4. Using m-learning will stimulate my curiosity.
PP5. Using m-learning will lead to my exploration.

5 Mobile Information System Use (MUSE) - involves the use of mobile devices to use an information system to "...carry out tasks and activities on the job for which the information system is designed to support" (Sun & Teng, 2012). Examples would include using learning management systems such as Blackboard and Banner.
MISU1. I use mobile information systems on a regular basis.
MISU2. I will continue to use mobile information system in the future.
MISU3. I intend to continue using mobile information systems.
MISU4. I want to continue using mobile information systems rather than discontinue.
MISU5. I predict I will continue using mobile information systems.
MISU6. I plan to continue using mobile information systems.
MISU7. I will stop using mobile information systems in the future.

Scale for question 6:

[1] strongly disagree, [2] disagree, [3] neither agree or disagree, [4] agree, [5] strongly agree

6 Rate each of the following statements:
I think that I would like to use mobile learning frequently.
I found mobile learning to be simple.
I thought mobile learning was easy to use.
I think that I could use mobile learning without the support of a technical person.
I found the various functions in mobile learning were well integrated.
I thought there was a lot of consistency in mobile learning.
I would image that most people would learn to use mobile learning very quickly.
I found mobile learning very intuitive.
I felt very confident using mobile learning.
I could use mobile learning without having to learn anything new.

7 To which gender identity do you most identify?
Male
Female
Transgender female
Transgender male
Gender variant/non-conforming
Not listed
Prefer not to answer

8 I am a (n)
Undergraduate student
Graduate student

If I am a (n) = Undergraduate student

9 What is your level?
Freshman
Sophomore
Junior
Senior

10 What is your age?

11 What is your major?

APPENDIX C
Mid-Pandemic Faculty M-Learning Activities Usage

* See section 5 for a detailed discussion of Appendix C

Activity	Never	Rarely	Occasionally	Sometimes	Frequently	Usually	Always
Email students	1	1	3	1	5	1	4
Email colleagues	1	1	3	0	6	1	4
Text students	5	4	2	4	0	0	1
Text colleagues	2	4	0	3	6	0	1
Post grades	3	3	2	3	2	0	3
Post to discussion board	3	3	3	6	1	0	0
Access course site	0	4	0	2	7	0	3
Access library resources	2	2	1	5	3	3	0
Access social networking	2	2	0	1	7	2	2
Order textbooks	7	2	2	2	1	1	1
Search internet	0	0	1	1	3	5	6
Provide tutoring services	6	5	1	3	1	0	0
Prepare lessons	4	1	2	4	1	2	2
Conduct seminars	7	2	1	4	0	2	0
Collect content for coursework	2	2	2	4	2	2	2
Read eBooks	2	3	2	4	1	3	1
Take pictures or make videos for course	2	2	2	4	4	2	0
Other (please specify)	5	11	0	0	0	0	0

Table 1: Mobile Device Use for M-Learning Activities for Teaching