



International Journal of
Gender, Science and Technology

<http://genderandset.open.ac.uk>

Gender Preferences in Technology Adoption: An Empirical Investigation of Technology Trends in Higher Education

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ABSTRACT

Mobile Learning (mLearning) technologies have rapidly expanded in utilization. These technologies are ubiquitous and inexpensive, and proliferate among various student populations. Preferences, by gender, for mLearning technologies among a higher education student population at a large research and teaching university in the United States are explored in this research article. Communications tools, collaborative tools and technology activity were analyzed according to gender. A cluster analysis was performed in order to categorize the data into two clusters: technology active and technology non-active. These clusters were then analyzed according to gender membership. The findings suggest that technology adoption is consistent across genders. However, there are some distinct trends in preferences that were discovered.

KEYWORDS

mLearning; mobile technology; mobile devices; gender preferences; technology adoption; educational technology

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INTRODUCTION

New technologies are pervading higher education, enriching the educational environment and facilitating learning. Mobile technology has made its appearance in the last few years, providing new possibilities for teaching and learning integrated in the existing educational practices. One such possibility is the utilization of mobile learning (mLearning) technologies in higher education to support the educational experience.

In this research article, the mLearning preferences and adoption characteristics are explored in relation to gender. Trends in technology and technology utilization are explored and reported. The findings suggest that technology adoption is consistent across genders. However, there are some distinct trends in preferences that were discovered.

LITERATURE REVIEW

A thorough literature review reveals that the definition of mLearning, especially in the context of higher education, is not clear, since mLearning is the summation of diverse, evolving concepts (El-Hussein & Cronje, 2010). However, key terms related to mLearning are *mobility*, *mobile devices* and *learning*. The term mLearning has been defined as "any type of learning that takes place in learning environments and spaces that take account of the mobility of technology, mobility of learners and mobility of learning" (El-Hussein & Cronje, 2010). Traxler (2005) defines mobile learning as "any educational provision where the sole or dominant technologies are handheld or palmtop devices" (p. 262). Handheld and mobile technologies include laptops, MP3 players, notebooks, mobile phones, tablets and any other portable devices that can be used as learning aids (Valk et al., 2010). As Sharples, Taylor, and Vavoula (2005) note, one of the key conceptual tenets of mLearning is the lack of spatial and temporal restraints upon learners.

The use of mobile technologies in the classroom has become a trend in higher education, growing rapidly as it overcomes the limitation of learning location with multiple advantages for the learning experience (Gikas, & Grant, 2013). These technologies hold promise for the disabled (Henning, 2016) and can provide learning-specific or directed content applications (Campbell & McColgan, 2016). However, the challenge discussed by Sharples (2002) remains: supporting and integrating mLearning effectively in and outside the classroom (i.e., technology adoption). The mLearning device is inherently portable and this portability provides unique opportunities and issues.

The portability of mobile devices has diminished the time and place restrictions of learning with traditional practices (Mottiwalla, 2007; Rossing, Miller, Cecil, & Stamper, 2012). This portability provides the opportunity to the users to access the educational content as it is convenient to them (Noelting & Tavangarian, 2003; Schreurs, 2008). Additionally, integrating technology into instruction creates new

opportunities for learning activities which increases students' engagement of different learning styles (Naimie, Siraj, Ahmed Abuzaid, & Shaghali, 2010; Rossing, Miller, Cecil, & Stamper, 2012). Furthermore, studies have shown that mobile technology facilitates the maintenance of students' engagement outside the classroom (Garrett & Jackson, 2006). Also, it enables collaborative, interactive learning and student-faculty interaction (Chen, Lambert, & Guidry, 2010; Conole, 2007; Nelson Laird & Kuh, 2005). Finally, Seta, Kukulska-Hulme, & Arrigo (2014), provide a discussion of the advantages of mobile technologies in facilitating lifelong learning (LLL).

All these advantages make the investigation of the determinants of mobile technology adoption critical. One such determinant may be gender. Gender differences in the adoption of technology have been studied in literature, producing mixed results. Regarding the Internet, usage studies have indicated that adult women are more likely to use communication tools or social engagement activities (Tsetsi, 2016), whereas adult men are more likely to use the Internet for information, entertainment, and commerce (Chigona, et al., 2009; Donner, Gitau, & Marsden, 2011; Jackson, Ervin, Gardner, & Schmitt, 2001; Subrahmanyam, Greenfield, Kraut, & Gross, 2001). Additionally, research has demonstrated that men's and women's attitudes toward technology differ significantly, with men indicating greater interest and knowledge and women indicating greater difficulty and reduced interest in using technology (Ardies, De Maeyer, Gijbels, van Keulen, 2015; Bame, Dugger, de Vries, & McBee, 1993; Comber, Colley, Hargreaves, & Dorn, 1997; Young, 2000).

However, these findings come from studies that were conducted several years ago, which indicates that men and women's attitudes toward technology may have changed considerably. More recent studies suggest that the original gender gap in computer and Internet use has almost disappeared, (DiMaggio, Hargittai E, Celeste, et al., 2004), but men and women use technologies in different ways (Odell, Korgen, Schumacher, & Delucchi, 2000). Bain and Rice (2006) studied the influence of gender on attitudes, perceptions, and uses of technology, but did not find significant differences. However, the qualitative analysis they conducted revealed that men consider themselves better at using a computer than women, and that they are more inclined to gender bias (i.e., believe that fewer women use computers; Bain & Rice, 2006). Additionally, Van Braak (2004) also found that girls felt less confident with computers than boys. The results of Lane and Manner's st revealed that women were less likely to own a smartphone, but they do consider the texting function very important. Finally, regarding mLearning, Snell and Snell-Siddle (2013) found that both men and women had similar perceptions of the mobile-enhanced learning environment.

Several theories have been developed attempting to explain which factors are related to the possible differences between the two genders. Ong and Lai (2006) examined gender differences in perceptions and relationships among determinants affecting eLearning acceptance based on the Technology Acceptance Model (TAM). They found that men's rating of computer self-efficacy, perceived usefulness, perceived ease of use, and behavioral intention to use eLearning, were all higher

than women's ratings, and women were more strongly influenced by perceptions of computer self-efficacy and ease of use (Ong & Lai, 2006). Additionally, they found that perceptions of computer self-efficacy and ease of use more strongly influence women's usage decisions, while men's usage decisions were more significantly influenced by their perception of usefulness of eLearning (Ong & Lai, 2006). Similarly, Padilla-Meléndez, del Aguila-Obra, and Garrido-Moreno (2013) found gender differences in the effect of playfulness in the student attitude toward a technology and the intention to use it. Women's attitudes toward the use of a system were influenced significantly by playfulness. In contrast, in men, this influence is mediated by perceived usefulness. Furthermore, it has been suggested that the differences in technology use can be attributed to gender role expectations (Kimbrough, Guadagno, Muscanell, & Dill, 2013). For example, Kimbrough, Guadagno, Muscanell, and Dill (2013) found that women, relative to men, are connecting more and are using mediated technology to a larger extent. Also, Huffman, Whetten, and Huffman (2013) found that men rated their technology self-efficacy higher than women, but they observed that gender roles, specifically masculinity, predict differences in technology use better than the biological sex. Finally, results indicated that performance expectancy, effort expectancy, social influence, perceived playfulness, and self-management of learning predict behavioral intention to use mLearning, and that gender differences moderate the effects of social influence and self-management of learning on mLearning use intention.

PURPOSE AND THEORETICAL FRAMEWORK

There exists much research in the areas of mLearning technology and technology adoption. Additionally, there is a great body of literature in gender preferences across a multitude of domains. However, as technology evolves, research is slow in keeping pace with new technologies, their utilization, and the preferences in men and women in using these new technologies. This gap in the research literature is the theoretical framework that supports this study.

The purpose of this study is to uncover gender preferences, if any, that exist in mLearning technology adoption for students in one large, Indiana, doctoral-granting university. The methodology utilized in this work is that of a quantitative cross-sectional survey.

Research Questions

The following research questions guided this article:

1. Are there any utilization/adoption differences in mLearning device technology between men and women within the sampled student population (i.e., graduate and undergraduate students in one large, Indiana, research and teaching university)?
2. Are there any utilization/adoption differences in mLearning application technology between men and women within the sampled student population?
3. How are these mLearning technologies being utilized by both men and women within the sampled student population?

METHODS

Subjects, Participation, and IRB

The survey population consisted of 20,503 graduate and undergraduate students, over the age of 18, at one large Indiana research (doctoral-granting) and teaching university. The participant recruitment was conducted via campus mass email in the Fall of 2014. The entire population was invited to participate. The response rate of participation was .7 percent, with 148 students electing to participate in the survey. This study was cleared through the Ball State University IRB office and the study procedures were cleared as "Exempt" under federal regulations. The assigned protocol number is: 601429-1.

Measuring Instrument: Design and Procedure

Data was obtained through the utilization of an online questionnaire, based on the eLearning Research Center (2013) work, and adapted (see details below) for web-based administration. The eLearning Research Center instrument contained a series of matrices of technologies cross-referenced with types of learning activities based on the DialogPLUS taxonomy (Conole, Latt, Dillion, & Darby, 2006).

Reliability and validity of research instrument.

The original survey instrument was developed through funding by the UK Joint Information Systems Committee (JISC). The genesis of the taxonomy is the Laurillard (2002) media type table. The original instrument validity and reliability testing as well as improvements were performed in stages utilizing four UK HE Academy subjects centres and the JISC e-pedagogy groups (Conole, Latt, Dillion, & Darby, 2006). The original instrument, taxonomy, or derivatives from them are used or cited in a number of studies including Steel and Levy (2013), Beach (2012), and Davison and Lazaros (2015).

Minor modifications were made to the original eLearning Research Center instrument. The modifications made were only functional in nature with the goal being the facilitation of the Qualtrics system. Specifically, a slider bar was added along with the selection boxes as used by Conole and colleagues (2006) in their original study.

Further validity and reliability testing was performed to examine the adequacy of the slightly modified web-based instrument used in this study. The feedback from this testing, which did not involve suggestions for major changes, focused on two main areas and resulted in the final instrument used in the study. The first area involved suggestions for verbiage clarifications. The need for clarification can in large part be attributed to the use of an instrument addressing students in the United Kingdom (e.g., "dorm" for US students instead of "halls of residence"). The second area of modification involved the suggestion of adding another modality of communication, social media, and adding tablet devices as a distinct device technology.

After the testing, the instrument was adapted and delivered through the Qualtrics analytics system. Upon giving their consent, the University communications office sent email solicitations to the student population inviting participation.

Implementation and Content

The study was conducted by surveying all students agreeing to participate in the study at a large Indiana research (doctoral-granting) and teaching university. Participants were emailed an invitation to complete a validated survey instrument. Following the data collection, the results were statistically analyzed utilizing the SPSS software package. The survey sample set (N) consisted of 148 participants. Students answered questions in three general domains relating to mLearning: digital technology usage, communication tool usage, and online learning facility usage. Next, the participants were asked several questions regarding their attitude toward mLearning technologies. Finally, students were asked to estimate their technology usage in their studies and their technology usage in their personal life.

RESULTS

The description of the qualitative and ordinal variables was based on absolute frequencies and percentages. The statistical comparisons between gender and the qualitative characteristics of the study were performed using the Pearson's chi-square test, whereas a test for trend was used for the by-gender comparisons of the ordinal variables. To identify profiles of technology use in the digital technology usage category and also reduce the dimensionality of the data, a Ward's linkage hierarchical cluster analysis was performed. The simple matching binary similarity coefficient was used as a distance measure, as all the corresponding variables were binary. The Calinski-Harabasz pseudo-F criterion was used to select the optimal number of clusters in each of the three domains.

The Pearson chi-square test is appropriate for evaluating the likelihood that any observed difference arises by chance. In this research study it was utilized in the statistical analysis of the gender preference in technology adoption differences. It is suitable for unpaired data and is a popular test for statistical significance.

Cluster analysis is used as a data mining tool to discover groups (clusters) of like data samples. In this research study, cluster analysis was used to categorize the data into two clusters: technology active and technology non-active. The implication is to discover if one gender is more inclined to utilize technology and many forms of technologies. The Ward's linkage hierarchical cluster analysis (Ward's method) is used to ascertain cluster member relevance while the Calinski/Harabasz pseudo-F statistic describes the variance ratio of cluster members and the clusters themselves.

Communication Tools Utilization

Our analysis revealed some differences between men and women in the use of communication tools for their studies. For communication with the other students, the communication tool with the highest popularity was email, with 85.4% of the participants using it, for both men and women (81.4% men and 85.7% women). That was followed by phone text messaging, with 65.1% of men and 65.7% of women using that modality of communication. Social media were used by both men and women for student communications, with more women (51.4%) than men

(37.2%) preferring it. However, the difference was not statistically significant (p -value=0.116).

Email was also the most popular communication tool for promoting collaborative learning tasks by both men (72.1%) and women (78.1%). However, phone message texting was preferred by more women (50.5%) than men (30.2%), which was a statistically significant result (p -value=0.024). Social media were preferred by both men and women equally for promoting collaborative learning tasks. Finally, only 8.1% of the participants used voice over Internet Protocol (VoIP) technologies such as Skype for this learning purpose.

Regarding the use of communication tools for the promotion of individual learning tasks, again email was the most popular communication tool, with 34.9% of men and 27.6% of women using it. Women and men used social media and phone texting equally for this learning task. However, more men (25.6%) than women (7.6%) used wikis for this learning purpose (p -value=0.003).

For information gathering within the context of mLearning, the most common communication tool used was email, with 27.9% of men and 24.8% of women using it. This was followed by wikis, which were also equally popular between men (30.2%) and women (22.9%).

Digital Technologies Usage

Table 1 shows the percentage of different device technologies usage as well as the percentage of those who did not use any form of device technologies. A total of 132 (89.2%) of the participants used laptop devices. Among men, 38 (88.4%) used laptops, while among women 94 (89.5%) used laptops. However, this result was not statistically significant. With regard to tablet use, 58.1% of the men and 39% percent of the women were using tablet devices. This was a statistically significant gender difference.

Table 1: Device Technology Preferences by Gender

	Gender		Overall	p-value
	Men N (%)	Women N (%)		
Laptop	38(88.4)	94(89.5)	132(89.2)	0.838
Tablet	25(58.1)	41(39)	66(44.6)	0.034
Smartphone	29(67.4)	60(57.1)	89(60.1)	0.245
Other	3(7)	2(1.9)	5(3.4)	0.121
None	2(4.7)	4(3.8)	6(4.1)	0.814

Cluster Analysis

A cluster analysis was performed in order to identify patterns in digital technologies usage. The resulting dendrogram and basic Custom Tables yielded two profiles. Profile A was more technologically active as people in this profile used digital technologies more than those in Profile B (within the context of mLearning, studies,

and education). Specifically, Profile A used laptops more for communication with the other students, for listening to course materials, information managing, planning group learning tasks, viewing course material, and assignment writing. Also the profile members used mLearning apps for communication with other students, collaborative and individual learning tasks, information gathering, listening to course materials, information managing, oral presentation, self-assessment exercises, and viewing course material.

Profile A used tablets more than Profile B for communication with teachers, for collaborative and individual learning tasks, information gathering, information managing, oral presentations, planning group learning tasks and individual learning tasks, reading course material, exam reviewing, self-assessment exercises, and assignment writing. Additionally, these profile members used iPods/MP3 players more for individual learning tasks, information gathering, listening to course materials, podcast for collaborative and individual learning tasks, information managing, oral presentations, and planning group learning tasks. Also, Profile A members used phone apps for collaborative learning tasks, information gathering, listening to course materials, oral presentation, and planning group learning tasks, and digital audio for individual learning tasks, information gathering, for listening to course materials, for information managing, and for oral presentation.

Table 2: Digital Technology usage Profiles by Gender

	<u>Gender</u>			p-value
	Men <i>N (%)</i>	Women <i>N (%)</i>	Overall <i>N (%)</i>	
Profile A	21 (48.8)	33 (31.4)	54 (36.5)	0.046
Profile B	22 (51.2)	72 (68.6)	94 (63.5)	

As it is demonstrated in Table 2, men, within their gender categorization, were evenly split between Profile A and Profile B. Women were overwhelmingly in Profile B. The percentage of men belonging to Profile A was significantly larger than the percentage of women, while the percentage of women belonging to Profile B was larger than men ($p\text{-value}=0.046$). Women made up a much larger overall *N* in this study and were largely represented in Profile B (less technologically active).

Thus, more men than women in the sample use multiple mLearning technologies such as laptops, tablets, iPods/MP3 players, podcast, mobile apps and mLearning apps for multiple educational purposes in their studies (e.g., communication with other students, reading course material, information gathering, listening course materials, planning group and individual learning tasks).

DISCUSSION

The results of this study indicate that there are only slight differences in (self-reported) technology preferences and utilization among genders. This is congruent with the more recent research on the topics, which is discussed above. Men and women consistently utilized devices and applications at approximately the same

degree; with the notable exceptions detailed in this study. The general trend appears to be that any gender gap in technology utilization is closing or nonexistent.

Communications and mLearning Tools

The usage of email was by far the preferred communication tool of both genders. Email was ranked high in all categories of communication including instructor interaction, student to student collaboration as well as individualized learning tasks.

With regard to gender preferences, the results show two interesting gender differences in communication tool utilization that were statistically significant. The first was in the context of collaborative learning tasks.

In communications for collaborative learning, text messaging was preferred by female respondents. More than half of the female respondents utilized this communication modality as opposed to approximately one third of the men sampled.

The second notable gender difference was in the context of individualized learning communications. Men tended to utilize wikis at a statistically significant higher rate than women. While both men and women did not prefer wikis for communication to any large degree (25% for men and less than 10% for women), the resultant gender differences were still notable and statistically significant.

Finally, there were two other statistically significant gender preferences with regard to communication tools. The first was male preference for utilization of Phone Applications (apps) for oral presentations. This was notable as approximately 20% of men preferred this tool as compared to women, with only 2% stating a preference for this tool. The Pearson chi-square asymptotic significance was .000 for this analysis.

The final notable gender preference for this study was apps for reading course materials. Men prefer this tool at approximately 25%, compared to women at less than 10% stating a preference for this mLearning tool. The Pearson chi-square asymptotic significance was .006 for this analysis.

Device Technologies

The overall result of this study indicates that laptops are the preferred device technology among all students, men or women. The laptop appears to be the utilitarian workhorse tool for students. For mLearning technologies: the laptop is king with approximately 90% of the respondents using this device.

One statistically significant difference between genders was noted in regard to device technology utilization: tablet devices. The percentage of men that used tablets was approximately 60%, while women were at 40%. The reason for this difference could have more to do with technology adoption and ownership than gender. Conversely, the utility of a tablet for the specific mLearning environment could contribute as well. Finally, the tablet is a newer technology. The Conole et

al. (2006) study did not have a device category for tablet, as the iPad and the Galaxy Tab were not marketed until 2010. As a result of instrument pilot-testing (see above discussion) the tablet was added as a distinct technology device.

Technology Activity

As the cluster analysis indicates (see Table 2 above), men tended to be the highest represented gender in the technologically active category, while a much lower percentage of respondents to the survey. The technologically active group members were those that, across all the survey responses, utilized applications and devices for mLearning to a high degree. As a statistically significant percentage, men were the majority of the group (Profile A).

This disparity appears to be more a result of women lacking membership in this group (Profile A) than male overrepresentation. Men were approximately equally distributed (as a percentage) in the technologically active group (Profile A) and the technologically inactive group (Profile B). Comparatively, women were underrepresented (as a percentage) in the technologically active group (Profile A) at approximately 37%.

Li, Glass, and Records (2008) studied technology activity in the context of gender and mobile commerce (mCommerce). In their work, they find that men and women adopt technology in similar rates, which is congruent with this study. Additionally, they find that men are more technologically active, which is also congruent with this study, by using a wider variety of mCommerce services. They suggest that this disparity is a result of men moving more quickly through the technology adoption stages. While that is a possible explanation for the gender differences in this study, it is not the only possible explanation. It is a suggested opportunity for future research to uncover the reason or reasons behind these phenomena.

LIMITATIONS

In this article, the gender preferences in technology adoption were explored. The data was obtained from a large Midwestern (east, central Indiana) research and teaching university. As the study is geographically bounded, this imposes a limitation on the generalizability of the findings.

Sociological, economic and psychological factors were not weighted in this study. There are a number of constructs such as socially ascribed gender roles, culture, and economic status that could impact technology adoption outcomes. In this study, a strict focus and limitation was put on the numerical representations and statistical analysis. These limitations could serve as the impetus for future research (see discussion section on future research suggestions).

As the survey recipients self-selected to respond, this may have some effect (self-selection and non-response) on the results. As noted previously, the survey did have a low participation rate, which could increase the probability of non-response bias.

While there are several techniques for estimating and correcting non-response bias (Armstrong & Overton, 1977), the extrapolation method was deployed in this research study. Several "successive waves" (p. 2) of email invitations to participate in the survey were sent out to the entire population. Each wave resulted in a large spike of participants followed by a period of no survey participation.

Armstrong & Overton (1977) also suggest that "subjective estimates" of non-response bias is a useful tool to estimate its effect. However, a clear technique to subjectively estimate non-response bias appears to be elusive. As the results of the survey are quite similar to the results of the survey upon which this one is based (Conole, Latt, Dillion, & Darby, 2006), there is a strong subjective indicator that the sample is valid.

SUGGESTIONS FOR FUTURE RESEARCH

There were some areas in which gender differences in technology adoption were found. Notably, in the application technology area, men tended to utilize wikis for learning tasks. Additionally, text messaging for collaborative technology was a more prevalent application technology among women. One suggestion for future research into software application adoption is to explore why. Concepts such as culture and socially ascribed roles should be explored.

With regard to device technology adoption, men tend to utilize tablet devices for mLearning purposes at a higher rate than women. Additionally, the cluster analysis indicates that men are more likely to be highly technology active or move through the technology adoption model more quickly. Another suggestion for future research is to explore these findings on device adoption and utilization from cultural and social perspectives.

Finally, this study could be replicated in other geographic regions. As data from this study was compared to UK students, data from subsequent research could be compared to these data and findings. It would be quite interesting to see the results from a more geographically diverse sample set.

CONCLUSION

In this article, the gender preferences in technology adoption were explored. The data were obtained through a cross-sectional survey of undergraduate and graduate students in a large Indiana research (doctoral-granting) and teaching university. The entire student body was emailed an invitation to participate in the web-based survey, and 148 students completed the validated instrument. The data was statistically analyzed using the SPSS software package.

Analysis of the data indicates some gender differences with regard to technology application adoption/utilization as well as technology device adoption/utilization across most surveyed categories. However, the statistically significant differences were not common, which indicates that in the overall sense, there is no gender gap with regard to technology adoption and utilization. Worthy of note in the application adoption domain were trends of men preferring wikis for individual learning tasks and female preference for text messaging for collaborative learning

tasks. Additionally, there appears to be a male preference for utilization of phone Apps for oral presentations, as well as a male preference for Apps for reading course materials.

From an overall device adoption perspective, the laptop is the preferred mLearning device across both genders. This would indicate that the laptop tends to be the go-to workhorse for mLearning. Interestingly, men tend to utilize tablet devices for mLearning at a higher rate than women. The authors offer no speculation as to why this phenomenon exists and suggest further research into it.

A further finding in this research study was the gender grouping for highly technologically active respondents. A cluster analysis was performed in order to identify profiles of technology use. The analysis results in two technology use categories: those who are highly technologically active and those who are not. The data suggests that women are underrepresented in the highly technologically active group, making up only 37% of that category.

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