iWant does not equal iWill: Correlates of mobile learning with iPads, e-textbooks, BlackBoard Mobile Learn and a blended learning experience

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This research tested the efficacy of a blended learning iteration with iPad tablet computers, an e-textbook and Blackboard's Mobile Learn application connected with a learning management system (LMS). Mobile learning was embedded into the pedagogical design of an undergraduate subject run in two semesters with 135 students. Using design-based research (DBR), an empirical investigation examined four variables including: iPad use; mobile technology use; attitude, including the unified theory of acceptance and use of technology (UTAUT) scale; and academic performance. Quantitative analysis with PASW Statistics included descriptive, scaling, correlations, partial correlations and ANCOVAs. Results suggested that students were positive about mobile learning, but were unconvinced that it made a difference to their learning. Performance variables demonstrated that age and self-managed learning attitudes were important covariates with academic success, and mobile learning per se was important but not independent from curriculum design and student engagement.

Keywords: mobile learning, higher education, e-textbook, learning management system, tablet computer, iPad.

Introduction and Literature

Much has been made of mobile learning and improved student experience and there is little question that the prospect of anytime, anywhere using small, yet powerful multi-purpose tablet computers is tantilising (Vavoula, Pachler, & Kukulska-Hulme, 2010; Guy, 2009; Kukulska-Hulme & Traxler, 2005). As with all new approaches to teaching and learning, the burden of proof must rest with the innovation, rather than the established approach. Yet, discourse on mobile learning and indeed, uses of emerging technologies in education more generally, readily presents assumptions about learning gains often based on observations of learner, teacher or administrator attitudes without testing the actual learning outcomes related to the technology use.

Belief in the legitimacy of the combined construct, mobile learning, is apparent in the literature including many educators claiming that student use of mobile technologies improves learning (Johnson, Levine, Smith & Stone, 2010). Mulholland's (2011) article, titled, *iPads strengthen education*, extolled the educational advantages of iPads, reported after a full year of use by school children in Chicago Public Schools. In the context of medical education, Sandars (2010) wrote that iPads "could revolutionise the way that we currently use technology to

facilitate teaching and learning" (p. 270). Whereas mobile learning is "championed" in the literature, there is clear indication that there is a need to refine the pedagogy (Elias, 2011, p.144).

Consistent with preceding realms of educational technology, the literature establishes the affordances of the technology to a greater extent than evidenced learning outcomes. In other words, the articles establish potential and aspiration rather than actuals and results. Keskin and Metcalf (2011) assumed a link between the affordances of mobile devices and learning. "Mobile learning has come to people's attention because mobile devices are portable, ubiquitous, easily accessible and used by many people. This situation shows that there is great potential to enhance learning with mobile devices" (p. 202). Beetham and Sharpe (2007) privileged technology in their definition of mobile learning as technology driven, miniature and portable, andas facilitating connected classroom learning. Similarly, Motiwalla (2007) focussed on mobility and learner behaviour more than learning per se by observing that mobile devices liberate the learner with anywhere, anytime learning. Wang, Wu and Wang (2009) explained that mobile learning "content is received through wireless Internet and palm-sized computers, and thus m-learning usage can be considered to be a natural extension of computer use" (p. 99). Recognising that a one-to-one relationship between mobile devices and learning cannot be assumed, researchers are beginning to consider the characteristics of mobile learning that potentially make it a positive pedagogy (James, 2011).
 Mobility is the term of choice used to connote untethered student experience with smart phones, tablets and netbooks, thereby making student materials light-weight and portable, and internet access allows students to access the content remotely using wireless networks. Writing in the context of English as a Foreign Language, Meurant (2010), for example, wrote that access to the iPad and wireless high-speed Internet connection has radically enhanced education.Such access, combined with germane learning tasks undoubtedly provide for learning opportunities in much the same way as other pedagogical processes are the repertoire of the constructivist educator, engaging the students in hands-on inquiry (David, Yin, & Chalon, 2009; Cavus & Uzuboylu, 2009; Motiwalla, 2007; Chao & Chen, 2009; Chen, Chang & Wang, 2008).

Discourse and research on mobile learning has mainly focused on the use of mobile phones (Johnson, Levine, Smith & Stone, 2010) and handheld computers such as the Palm operating system devices (Finn & Vandenham, 2004) as tools with which students access course content, if not produce work that produces learning outcomes.Kukulska-Hulme and Traxler (2005), for example, discussed the use of e-texts on Windows Mobile operating system phones and personal digital assistants (PDAs) in Open University courses. Their primary focus was on efficacy of mobile devices compared with established tethered personal computers in distance education systems that had relied heavily on internet connected PCs.In a similar vein, Liaw, Hatala and Huang (2010) researched attitudes toward mobile learning with surveys of n=152 university students. The researchers found that positive perceptions toward mobile learning increase when the curriculum is designed for autonomy to facilitate self-managed learning and is highly interactive. Cavus and Uzunboylu (2009) studied 41 undergraduate computer education students who answered attitude and critical thinking measures following use of mLearning devices. The authors questioned whether use of mobile devices promoted critical thinking and whether they had a measurable impact on student creativity, finding that student attitudes toward mobile learning improved significantly and critical thinking improved somewhat as use of mLearning devices increased. It should be acknowledged that the authors did not directly measure the critical thinking in terms of learning outcomes, but instead relied on indirect attitudinal questions of the students.

Chao and Chen (2009) designed an experiment to determine whether there were significant differences when students used paper-based versus mobile learning approaches to reading and note-taking. The researchers then elaborated on the experimental findings with an intensive case study. In their first study, 40 undergraduate students were randomly assigned to two groups of 20 each. The experimental group used mobile devices while the control group did not. In the second study, six participants participated in a follow-up case study in which their mobile learning tasks and device use were studied with system logs, diaries and interviews. The researchers found, unsurprisingly, that students used a blend of paper-based texts, personal computers and mobile devices for learning tasks. There was no significant difference in knowledge retention between the experimental and control groups.

This emerging body of mobile learning research attempts to explore a pedagogical link between mobility and learning, but provides limited empirical evidence that this connection has been established. This state of affairs is understandable inasmuch as research into mobile learning is "maturing" as no "explicit frame exists as yet to guide the choice of research methods and the tools for data analysis" (Pachler, 2009). Park (2011) **wrote that mobile learning is under-theorised . "Despite the many forms of and increasing services offered by mobile learning, it is still immature in terms of its technological limitations and pedagogical considerations" (p. 79).** The protean nature of mobile learning research, then, raises questions not only about its efficacy, but also

about the constructs used in discourse about the phenomenon in university teaching and learning.

Even though mobile learning invokes notions of portable educational process, others have observed that the definition of mobile learning cannot be simplified into compounding the two terms (Guy, 2009). The side-by-side arrangement of the two words makes mobile the adverb of the verb learning. Learning connotes a more established or better-understood idea. For example, "learning is always the learning of some particular content" (Ramsden, 2003, p.49). To have learned means that a student has demonstrated a measured component of a set object or curricular domain and it is therefore baffling that mobile learning research has been centered around the feature of mobility as opposed to constructs of critical thinking and development of understanding (Laurillard, 2009).

Indeed, if learning takes place within the subjective experience of the learner, it is, to some extent, always mobile! The carriage of learning tools for decades, if not centuries, has been definitively a mobile process. Thus, while we focus on new tools, educators must also continue their focus on Ramsden's (2003) notion that learning takes place naturally and that the learning of a particular must necessarily be observed to claim the particular has been learnt, regardless of adjectival context of learning. In their examination of early mobile learning trials, Finn and Vandenham (2004) wrote, "while new technologies can offer new and creative modes of learning, the primary educational goals remain the same: to equip students with a set of skills and knowledges that will help prepare them for later life" (p. 32). Research into *learning* through ubiquitous educational technologies envelopes the concept of mobility, whereas research into *mobility* does not assure educators that the technologies are making a difference to *learning*.

In this context, much of the "buzz" around mobile learning appears to be a nascent and collective sense that students need mobile device skills that enable workplace productivity to ensure they have the professional capacity to use mobile tools effectively upon leaving the university education system. Debates about uses of computers and phones in the classroom in the short term may begin to centre on diminishing their use for non-academic and personal social networking and increasing their use for academic and productive use of mobile tools.

Mobile learning research may then re-situate the agenda on the operational definition of best practices in curriculum, pedagogy, teaching and learning (Kukulska-Hulme, & Traxler, 2005), rather than on its distinctiveness from other contexts of learning. In other words, mobile learning becomes nothing more and nothing less than good educational practice involving inquiry-based pedagogy with which students are engaging with real-world content in active processes that resemble those used by industry professionals (Jardine, Clifford & Friesen, 2008).

Moreover, focus on particular technologies is problematic not only in education but in almost any context as long as attention to them is situated in the now and the static rather than in the past, future and context and the dynamic nature of technological change. Early studies such as those cited above have defined mobile learning technologies in the context of the times in which the studies have taken place. As new technologies for mobile work emerge, studies are needed to assess not only the tool and the pedagogical context in which it may be used, but also the attitudes surrounding its adoption and subsequent use. This explains, to some extent, the focus on student attitudes in the literature on mobile learning.

Wang, Wu and Wang (2009) tested the unified theory of acceptance and use of technology (UTAUT) instrument, developed by Venkatesh, Morris, Davis and Davis (2003), with 330 students specifically in relation to mobile learning. The UTUAT is a multi-dimensional scale incorporating eight dimensions used in the field of information technology to assess user acceptance attitudes toward introduced technologies with a particular focus on workplaces. The model argues that acceptance of information technologies in organizations is an interplay between individual reactions to using those technologies, leading to intentions to use them and then having experience and use of said technologies. This model provides a powerful empirical tool with which to examine attitudes toward and use of mobile learning and other educational technologies to determine important correlates of use and subsequent learning or grade performance outcomes.

Wang, Wu and Wang (2009) provided a useful and concise summary of the detailed testing and attitude models tested extensively by Venkatesh and his colleagues.(2003) "UTAUT posits that performance expectancy, effort expectancy, social influence and facilitating conditions are determinants of behavioural intention or use behaviour, and that gender, age, experience and voluntariness of use have moderating effects in the acceptance of it" (pp. 95-96). Although the extensive literature and assumptions behind the UTUAT are beyond the scope

of the present paper, it is worth defining the key scales and constructs that make up the UTAUT as provided by Venkatesh and his colleagues.

Performance expectancy is the "extent to which an individual believes that using an information system will help him or her to attain benefits in job performance" (Venkatesh, et al., 2003, p. 447). Effort expectancy is "the degree of ease associated with the use of the information system" (p. 450). Social influence is the extent to which a person perceives that important others believe he or she should use a new information system" (p. 451). "Attitude toward using technology is defined as an individual's overall affective reaction to using a system" (p. 455). Facilitating conditions are "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system," (p. 453). Self-efficacy is the ability to garner one's confidence, skills and abilities in order to accomplish a required task. Yang's (2010) literature review and research led him to conclude "the level of consumer self-efficacy can predict individual consumer's mobile data service adoption behavior" (p. 119). Anxiety is the evoking of "anxious or emotional reactions when it comes to performing a behavior" such as using a computer (p. 432). Behavioural intention to use the system, based on the Fishbein and Ajzen's (1975, cited in Venkatesh et al., 2003) theory of reasoned action is the self-reported intention to engage in a particular behaviour. In addition to these models, Venkatesh and colleagues argued that experience with a system, essentially the perceived or actual amount of time spent using it in the past, voluntariness of use or "the degree to which use of the innovation is perceived as being voluntary, or of free will (Moore and Benbasat (1996) in Venkatesh et al., 2003, p. 431), were critical variables in determining attitudes toward technologies.

Wang and colleagues (2009) noted that the UTAUT had been developed primarily from research completed in the context of workplaces and did not apply perfectly to the context of higher education and mobile learning in particular. They added to the scales used with UTAUT self-management of learning and playfulness and, in their study, chose not to include use behaviour, facilitating conditions, experience in using the technology system, or voluntariness of use but later wrote, "continued research is needed to investigate... behaviour, facilitating conditions and experience" in mobile learning (p. 113). Perceived playfulness was defined as "a state of mind that includes three dimensions: the extent to which the individual (1) perceives that his or her attention is focused on the interaction with the m-learning (i.e., concentration); (2) is curious during the interaction (i.e., curiosity); and (3) finds the interaction intrinsically enjoyable or interesting (i.e., enjoyment)" (p. 99). Self-management of learning was defined as "the extent to which an individual feels he or she is self-disciplined and can engage in autonomous learning" (p. 101).

Findings from the Wang, Wu and Wang (2009) study investigating the UTAUT in the context of mobile learning demonstrated that students' intentions to use mobile learning tools were determined in large part by performance expectancy, effort expectancy, social influence, perceived playfulness, and self-management of learning variables. Moreover, they found that age moderated the influence that effort expectancy and social influence had on intentions to use mobile learning. While their goal was to apply the UTAUT to mobile learning, a simple way to extend this research would be to investigate the relationship between components of the UTAUT, perceived playfulness and self-management of learning on the one hand with actual use of mobile learning tools - particularly newly introduced tools - and actual academic performance as a proxy for learning.

The introduction of mainstream tablet computers over the past two years is rejuvenating and extending inquiry into mobile learning. That tablet computers have become more capable and therefore provide untested opportunities for mobile learning raises additional questions about what mobile learning means and how it works to enhance the experience of learners. The introduction of the Apple iPad in 2010, as well as the growth of applications or "apps" for the mobile technology ecosystem of the "iOS" or iPod, iPhone and iPad operating system may well be a part of such rejuvenation. Mainstream publishers of textbooks have begun producing apps for the iOS environment. In the absence of apps, publishers have produced ePub or Kindle formatted textbooks more easily read on tablets than on phones, but importantly compatible simultaneously with both pocket-sized and tablet-sized devices. Learning management system firms, similarly, have introduced applications beyond Internet browser interfaces with which students can access course content. In some ways, and for those with decades of experience in education, the rapidity and hyperbole surrounding mobile devices appears similar to that of the personal computer three decades earlier.

Such buzz reinforces ongoing questions about mobile learning not well answered by the literature to date. For example, to what extent are university students using mobile devices in their learning experience? Do students perceive that the use of mobile devices in their university education makes a difference to their learning? Do those students who use mobile tools demonstrate higher levels of learning, at least in terms of summary academic performance?

Research Questions

Based on the literature, and attending particularly to the need to establish an indication of the relationship between use of mobile learning technologies, attitudes toward their use (e.g., the UTAUT) and academic performance in relation to the latest available mobile learning tools, we sought to answer the following research questions.

1. What mobile learning technologies do students currently bring with them to the classroom?
2. What attitudes toward using mobile learning technologies are demonstrated particularly in relation to tablet computers, e-textbooks and LMS applications on mobile devices?
3. What is the observed relationship between use and attitudes of mobile learning tools and academic performance as a proxy for learning?

Methods

Mobile learning was embedded into the pedagogical design of an undergraduate subject run in two semesters with a total of 135 students. Using design-based research (DBR), an empirical investigation examined iPad use variables, mobile technology use variables, attitudinal variables including the unified theory of acceptance and use of technology (UTAUT) scale, and academic performance variables. Quantitative analysis with PASW Statistics included descriptive, scaling, correlations, partial correlations and ANCOVAs.

Research Design

Design-based research (DBR) was used for this study (Middleton, Gorar, Taylor & Bannan-Ritland, 2008; Wang & Hannafin, 2005). DBR allows a natural symbiosis between research and learning by evolving observation of students in a natural setting. In order to answer the research questions about students' behaviours, attitudes and learning, it was important that the research conditions did not interfere with the integrity of their phenomenology as undergraduate university students. The primary reason DBR was selected for this project was that instead of using artificial experimental contexts, students were volunteer research participants who spent no more time than normally spent engaged in class activities that were what they would ordinarily expect in a university classroom facilitated by their lecturer.

The pedagogical design of this subject was such that the educator used a combination of face-to-face teaching methods such as lecture and tutorial discussion and online methods such as immediate internet search and online formative assessment. Students were invited to use their own mobile devices such as netbooks, laptops, internet-enabled mobile phones and tablets to participate in the mobile learning components of the class.

The only novelty in the experience was that a loan scheme ensured all students had use of iPads pre-loaded with an electronic (e-pub) copy of their normally assigned textbook (converted for the study by the textbook publisher, Oxford University Press) and the Blackboard Mobile Learn application providing easy access to the learning management system (LMS). The iPad loan schedule allowed students to take home and use the device for a one-week period twice during the semester.

In keeping with the DBR method, student use of mobile devices had to be consistent with regular timeframes and locations (Wang & Hannafin, 2005). Use of mobile devices spans formal and informal settings (Sharples, 2009). Therefore, students had natural free reign with the mobile devices during the loan period. They were free to take them home and to load whatever applications they wished during the loan period.

Participants

A total of 135 students who were enrolled in an undergraduate subject titled *Digital Media and Society* in the final semester of 2010 and the first semester of 2011 participated in the study. To meet the requirements for ethics including self-determination, students were not coerced to participate, but were advised of the project through the LMS and a letter signed by the Chief Investigators (CIs) from an appointed postgraduate research assistant who coordinated the participant list and managed data de-identification. Although one CI was the academic responsible for the subject and marked most of the assessment items, a tutor was also involved in marking the minor assessment included in the dependent variable metric and the subject leader CI was blind to the volunteer participant list.

Measures

In total, almost 300 data points informed the measures for this research. As the key data collection instrument of

the DBR process, students completed weekly formative and summative assessment tasks including end-of-lecture surveys and quizzes, four written essay assignments that were published as publicly available blogs on services such as WordPress and Blogger, and a podcast published in iTunesU with the students' permission upon completion of the semester. Students also completed an end-of-term final examination required by the University of survey-size major subjects. To answer the research questions, the weekly surveys provided demographics, behavioural and attitudinal data, and the quiz component (usually three questions) provided evidence of weekly knowledge gains. The lecturer has used these surveys for many years as a way to relate group demography and topical information about subject-domain drawn from students' own experiences and perspectives.

Overall subject scores were used as one general metric of learning performance. Students participated in one tutorial group discussion lasting 30 minutes the week following their use of the iPad; research from these sessions has been reported elsewhere and is not included in this report. However, students also completed a survey of their use of borrowed iPads and these results are discussed here.

The substantive measures from the unified theory of acceptance and use of technology, or UTAUT scale (Venkatesh, Morris, Davis and Davis, 2003; Wang, Wu and Wang, 2009), served as the survey questionnaire for the last lecture meeting of the semester. The modified form of UTAUT adapted by Wang and colleagues (2009) including wording related to mLearning was adapted for this research with scale results reported below.

Analyses

Data were analysed using mixed methods (Somekh & Lewin, 2005) for multiple facets of the project. The results reported here were analysed using PASW Statistics Version 18 on both Windows and MacOS computers and sought to include psychometrically valid reporting (Crocker & Algina, 1986; Marshall & Rossmann, 1989). Frequencies, means and similar descriptives were used for demographic and behavioural measures. Scaling analyses included Cronbach's Alpha analysis of the UTAUT subscales. Bivariate and partial correlations were used to assess the relationships among key demographic, behavioural, attitudinal and learning outcome measures and ANCOVAs were performed to assess the impact of iPad use on grades.

Results

Sample Description

Of the 135 undergraduate students who participated in the project, 63% were female. Modal age was 21 years (mean=22, range=19, standard deviation=3.9 years). Sixty percent were enrolled in the subject as required for their major or degree while 25% were enrolled for elective credit and 15% were study abroad students. The final grade distribution for these students was slightly skewed with 40% earning a *Pass*, 28% a *Credit*, 20% a *Distinction*, 7% a *Fail* and 5% a *High Distinction*.

Behavioural Self-reports on Technology Use at University

Use of the iPad was not compulsory and despite the opportunity to use the iPad during the semester, 36% of students decided not to borrow it, 54% borrowed it once and 10% borrowed it twice.

The first research question asked what mobile learning technologies do students currently bring with them to the classroom? The answer is that they come well equipped with a mixture of mobile and computing technologies and services, but tablet computers were in the early stages of adoption in late 2010 and early 2011.

Personal computer ownership among the sample was almost universal (98%) and most of these (92%) being laptops (13% reported using desktops with some indicating ownership of two computers); slightly more (54%) were running a version of the Mac operating system, 45% running a version of the Windows operating system and only one running a version of Linus. Notably, 83% said they also used computers provided in the university labs. Computer use throughout the day was reported by 63%, twice a day by 18%, once a day by 15% with the rest reporting less frequent use.

Almost all (96%) brought a mobile phone to class, and nearly half (48%) brought a laptop to class with only 4% of these being netbooks. Few (4%) brought a tablet computer to class. Mobile phones used by students were mostly Internet enabled (73%). Of those phones with either Wi-Fi or 3G or EDGE Internet access, students reported that 80% were primarily used for social networking, 75% for web browsing and 68% for email.

All but one student came to class stating that they were already subscribed with a Facebook account. Half had a Twitter account and one fifth had Linkedin accounts. Twitter was used throughout the semester with a unique hashtag to encourage community and student engagement. By the middle of the semester, 81% of students reported using it.

Use of mobile phones and laptops were evenly split during class time with half stating they regularly use their phones and half stating they regularly use their laptops. Of the students who stated they bring their laptops to class, half stated that primarily, they used the university's LMS, half that they use their laptops to take notes, half state that they go on Facebook, a third stated that they access Wikipedia. Of those who stated they regularly brought their mobile phone to class, a third reported texting at some stage during class.

Despite these tech-heavy frequencies among this sample of students, only 14% identified themselves as "power users" of information and communication technologies and 36% described themselves as tech-savvy. The majority (46%) said they were merely "tech-users." Tellingly, none self-identified with the label "tech-resister." Screens were used heavily for composing and reading, although e-books were preferred over printed books by few (11%) and only 26% had read an e-book over the course of the past year.

However, the iPad loan appeared to facilitate e-text reading and other productivity behaviours among those who borrowed it. For example, when asked whether they had completed any of the assigned readings from the e-textbook on the borrowed iPad in a given week, 66% said they had; further, 59% said they had completed readings that had been assigned from online resources using the loaned iPad. Late in the semester, when asked the question, "I grew to prefer the e-text over the print edition," 30% disagreed, 22% neither agreed nor disagreed, but 48% agreed.

More students used the Blackboard Mobile Learn app with 77% indicating they had used it. Only 30% tried to use the iPad to take notes, but 76% used it for email and 88% for Facebook reading and 79% for Facebook status updates. Although invited to install apps, only 43% did so.

Attitudes About Mobile Learning Technologies

The second research question asked what attitudes toward using mobile learning technologies are demonstrated particularly in relation to tablet computers, e-textbooks and LMS applications on mobile devices. In short, although reported attitudes generally affirm Bond University's policy to support mobile learning and tablet computing, analysis indicated there is little need to rush to satiate student demand.

A large majority of students feel there is benefit in blended learning with internet-connected devices used during class. Only 12% said there was "little benefit" or "no benefit at all" while 43% said there was "reasonable benefit" and 45% said there was "a lot of benefit" in their use. Nevertheless, when asked how much distraction results from using internet-connected devices during class, 27% said "a lot of distraction," 37% said "reasonable distraction" and 36% indicated "a little" or "no distraction." Asked whether the iPad motivated them to learn, 22% said it did not, 32% sat on the fence and 46% said it did. Similarly, 48% said the iPad "gave me an advantage in the classroom," while 17% did not think so and the rest were neutral; 44% said the iPad "improved my study habits" while 21% did not think so and the rest were neutral.

Results of the UTAUT Scale

In general, the modified UTAUT instrument (Wang, Wu & Wang, 2009) provided subscale measures that held up to minimum standards of internal consistency (Table 1). Reliability estimates of the four-item subscales ranged from alpha=0.45 to 0.85. Cases were omitted where students did not complete the activity or in instances where one subscale item was not completed by a participant. These results included modest wording changes along the lines of Wang and colleagues (2009) and invoked reference to tablet computers in particular.

Table 1: Modified UTAUT Reliability Results

Subscale	Cronbach's Alpha	Mean (7 = Max)	N of Items	N of Cases
Performance Expectancy	.85	4.6	4	105
Effort Expectancy	.80	5.5	4	105
Attitude Toward Using Technology	.85	4.9	4	105

Social Influence	.79	4.6	4	104
Self-efficacy	.57	4.9	4	105
Facilitating Conditions	.62	4.9	4	106
Anxiety	.63	3.8	4	105
Behavioural Intentions	.80	4.5	4	106
Self-managed Learning	.65	5.0	4	104
Perceived Playfulness	.45	4.4	4	104

Students in this study demonstrated a level of mobile and tablet technology self-assurance. Although effort expectancy is high, perceptions of both self-efficacy and university support (facilitating conditions) are similarly high while anxiety is relatively low. Nevertheless, students appear to be lukewarm about the performance gains they would expect from mobile learning in their blended learning environment and believe in their ability to self-manage their learning.

Relationships Among Key Variables

The third research question asked what is the observed relationship between use and attitudes of mobile learning tools and academic performance as a proxy for learning.

Bivariate Correlations

Bivariate correlations of the key demographic, behavioural, attitudinal and performance learning variables indicated on first inspection that age and self-management of learning are obvious important factors in mobile learning outcomes. So too are iPad borrowings and attitudes toward technologies and having a low level of anxiety or, in other words, self-assurance.Table 2 summarises these key relationships.

Table 2: Important Correlates of Mobile Learning with the iPad

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	1												
2. No. iPad Borrowings	.17	1											
3. Quiz Average	.00	.24*	1										
4. Overall Grade	.21*	.28*	.51*	1									
5. Perform. Expectancy	.14	.11	.20*	.01	1								
6. Effort Expectancy	.04	.05	.13	-.02	.31*	1							
7. Att Toward Using Tech	.22*	.14	.20*	.09	.83*	.40*	1						
8. Social Influence	.21*	.01	-.01	-.13	.64*	.23*	.60*	1					
9. Self-efficacy	.07	.05	-.02	.06	.50*	.31*	.50*	.37*	1				
10. Facil'g Conditions	.00	.00	.15	.12	.22*	.25*	.24*	.29*	.49*	1			
11. Anxiety	-.36*	-.04	.00	-.36*	-.23*	-.25*	-.15	-.11	-.27*	-.13	1		
12. Behav. Intentions	.08	.08	.15	.05	.65*	.21*	.58*	.39*	.39*	.25*	-.23*	1	
13. Self-mgd Learning	.31*	.01	.11	.38*	.30*	.20*	.38*	.24*	.39*	.18	-.22*	.27*	1
14. Perceived Playfulness	.08	.12	.14	.02	.51*	.22*	.56*	.55*	.29*	.26*	.14	.18	.29*

* p < .05

Partial Correlations

Partial correlations of these relationships demonstrate the importance of state variable such as age. Controlling for age, the relationship between the number of iPad borrowings and grades is reduced to 0.18, falling short of significance. Thus, age is an important covariant in grade outcomes when considering the affordances of tablet mobile computing. However, controlling for self-managed learning, the relationship between grades and iPad borrowings increases the relationship between grades and borrowings to 0.32, p<.001. This curious outcome suggests multicolinearity between age and self-managed learning, not necessarily indicated by the bivariate correlation between the two measures. A partial correlation of iPad borrowing and grades, controlling for both age and self-managed learning drops the relationship back to 0.29, still a significant relationship.

ANCOVA Results

To further parse the relationship between iPad borrowing (which may have been none, once or twice) and grades, we submitted a series of models for a univariate ANOVA with age and self-managed learning as the covariates. The model we explored set = iPad borrowings (3 levels) as the independent variable, overall course grades as the dependent variable and age and self-managed learning as the covariates. The results indicated that when controlling for age and self-managed learning, those who used the iPad more, particularly those who borrowed it twice, also had the highest grades (F=7.32, df=4,76, p<.001).

Discussion and Conclusion

Research into mobile learning is exciting both for its student learning potential and as a newly emerging sub-domain in educational research. Because this nascent field is the focus of emerging literature, opportunity abounds for research to make a meaningful contribution. The conditions of the design-based research described here were such that 135 students enrolled across two semesters of an undergraduate class, were invited to borrow iPads for up to two one-week periods. On these iPads were tools related to knowledge domains tested at intervals and at the end of the semester and covered in formative assessment along the way. The three research questions drawn from the literature sought to examine the mobile learning tools students were using upon their arrival to the subject, their attitudes toward mobile learning, particularly with tablet computers such as the Apple iPad, and whether measurable learning gains as measured by overall grades could be observed as a result of exposure to a blended learning environment with tablet computers.

For the 135 students who participated in this research, it appears that the affordance of a new learning tool in a blended learning environment added modestly to their existing tool-chest of technologies and provided stimulus to achieve and warm, if not enthusiastic, attitudes toward the emerging mobile learning platform of the tablet computer, and added something to their performance. Indeed, it seems that those who borrowed the iPad twice had the highest grades after controlling for age and self-management of learning (both of which are positive correlates with grade performance).

There are other meaningful findings to be drawn from this research. That students in the age range of 18-40 have positive attitudes toward technologies as measured by the UTAUT subscale, and that age is positively correlated with attitudes toward technology is at first surprising. However, older, mature students, returning to university with purpose, represent a uniquely motivated and, perhaps, technologically savvy group of learners. The negative correlation between age and the anxiety subscale similarly indicates purpose and self-confidence with age at least up to the maximum age in this sample.

Also worth note is the usefulness of the UTAUT and the internal consistency among subscales. The findings are worthy of a separate paper and the contribution to the present analysis has been of great heuristic and generative value.

These findings are, as always, preliminary and should be treated with caution. On the face of it, the results seem to invoke notions of the Hawthorne effect in which a novel stimulus generates increased arousal and thus, for some, better performance. That those who borrowed the iPad had better grades, is perhaps indicative of the students' motivations and eagerness to learn, eagerness to use technology, and eagerness for innovation and engagement in the classroom. Certainly the results indicate that the ability to use Internet-connected technologies during class is important to students, particularly in a class on *Digital Media and Society*!

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