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Introducing a Mobile Learning Attitude Scale for Higher Education

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Abstract
The Mobile Learning Scale v1.0 consists of seven Likert items drawn from the key points developed for a paper on mobile learning prospects for informal learning in higher education (Khaddage & Knezek, 2011). Many of these points had been initially developed during the 2011 International Summit on ICT in Education (UNESCO, Paris, 2011), where the first author was Rapporteur for the working group Co-Chaired by the second author. In order to assess the performance of the instrument, data were gathered from 81 undergraduate and graduate university students during August and September of 2011. Data were assessed for strength of agreement on individual items and for internal consistency reliability of the seven-item scale. Initial indications are that the instrument has good reliability for university students (Alpha = .85) and can be useful for assessing attitudes toward mobile learning technologies and applications within the intended audience of higher education learners. Potential uses and plans for future research are discussed.

Keywords
attitude scale, mobile learning, higher education, informal learning

INTRODUCTION
Mobile learning is a relatively new phenomenon with its theoretical basis still under development (Kearney, Schuck, Burden, Aubusson, 2012). Nevertheless, with the rapid growth of mobile devices throughout the world (World Bank, 2012), the need has emerged for studies of affordances and barriers that might enhance or constrain the adoption of mobile learning in higher education. This approach is consistent with the principles of diffusion of innovations (Rogers, 2003) that have served as a useful model for studying the introduction of new information technologies in the past, and which have been suggested by Cheung and Hew (2009) as an appropriate framework for examining the uptake of mobile devices in teaching and learning. Some studies (eg. Motiwalla, 2007) dating back as far as a half-decade have surveyed the perceived usefulness of mobile learning for higher education, but in a search of the literature the authors found no well-established, concise survey instrument to assess attitudes toward mobile learning as a means of examining perceived affordances and barriers to adoption of mobile learning in higher education.

A turning point for development of the current instrument occurred in June of 2011. During participant discussions at the Second International Conference on ICT

in Education (EDUSummIT 2011, UNESCO, Paris, France, June 2011), 135 researchers, policy makers, and association leaders from 41 nations reached consensus on the rapidly emerging role of mobile learning tools and applications in formal and informal learning. As Rapporteur and Co-Convener, respectively, for one of the eight working groups at EDUSummIT 2011, the authors of this paper summarized main points from discussions and subsequently developed a Likert-type Mobile Learning Scale with seven items reflecting key points emerging from the EDUSummIT 2011 dialog. Since that time, in August and September 2011, the instrument was pilot tested with 81 undergraduate and graduate students attending four classes in a large Midwestern university in the USA, with a preliminary analysis of the instrument presented to the World Educational Research Association conference in Kaohsiung, Taiwan (Knezek & Khaddage, 2011). Feedback from that forum and new analyses completed during 2012 are incorporated into this paper.

CONCEPTUAL RATIONALE

With the tremendous increase in accessibility of digital technologies in the last decade there has been a drastic change in the way that young people play, socialize, and communicate (Ito, Horst, Bittanti, Boyd, Herr-Stephenson, Lange, & Robinson, 2008; Sefton-Green, 2004). The way that young people use digital technologies in out-of-school settings and the intensity with which digital technologies are being used has challenged the educational community to rethink the nature of learning in informal settings, and how informal learning can inform formal learning. It is now recognized that learning occurs in different settings, and school is only one of them (Hsi, 2007; Lewin, 2004). Education today takes place in a much broader context than the confines of school walls or traditional curricula.

Scolari, Aguado, and Feijoo (2012) listed education as a major classification category in their taxonomy of mobile media contents and applications. Voogt, G. Knezek, Cox, D. Knezek, and ten Brummelhaus (2011) specified developing new assessments designed to measure outcomes from technology enriched learning experiences (p. 2) as one of eight action items emerging from the first International Summit on ICT in Education (EduSummIT 2009) held in the Netherlands in 2009. When further developing new ideas emerging from the second International Summit on ICT in Education described in the introduction to this paper, Knezek, Lai, and Khaddage (2011) found an increased emphasis on the EduSummIT 2009's call to establish a clear view on the role of ICT in 21st century learning and its implications for formal and informal learning (Voogt et al., 2011, p. 2) and increased urgency for understanding how learning in formal and informal settings can be bridged by using mobile technologies (Knezek, Lai, & Khaddage, 2011).

Some participants in EduSummIT 2011 have more deeply addressed the needs identified in the previous paragraphs in scholarly venues. For example, Cox (2012) contended that because over the past 50 years the balance between teacher and learner roles in engagement with IT has shifted from the teacher in the classroom more toward the learner inside and outside the classroom, and because the current movement in hand-held devices is away from the bundled standard applications software which "diminished the uses of investigative subject based software in schools" (p. 4), research approaches investigating innovative ways of teaching and learning with IT in the future should address technology-enhanced learning "outside formal educational settings" (p. 2) as well as the opportunities presented by "the uptake of thin client technologies" (p 5) that are mobile and personalized. Lai (2011) devoted the final section of his work on digital technology and the culture of teaching and learning in higher education to "… how digital technologies may provide a more active and flexible learning experience by adopting a participatory pedagogical approach and by blending formal learning with informal learning" (p. 1263). Arguments presented by these and other authors collectively provide a scholarly ra-

tionale for the emphases on learner perceptions of mobile devices and applications (Apps), and ways in which they can contribute to informal learning, in the mobile learning attitude instrument presented in this paper.

Thus, there is an established need for a mobile learning instrument developed from a scientific perspective, to gather data/information about students' perceptions and acceptance of this type of learning method. As stated by Naismith, Lonsdale, Vavoula, and Sharples (2004, p. 36), the challenge is now for educators and technology developers of the future to find a way to ensure that this new learning method is highly situated, personal and collaborative for the long term, and accepted by students. In other words, it should be a truly learner-centered environment. Therefore, since it is learner-centered, educators should focus on the students and study/monitor and observe them closely. Researchers should gather accurate data that can lead to efficient and effective information to help identify students' attitudes, level of acceptance, opinions and expectations regarding the integration of mobile applications into teaching and learning. This approach is what Andrews and Tynan (2012) have referred to as "investigating the human voice" (p. 565) in order to meet the unique needs of today's distance learner. Hence, by creating instruments such as the one introduced in this paper, we can precisely and efficiently assess reliability and validity and make continuous refinements, allowing perceptions of mobile systems and applications to be accurately measured. This in turn will enable systematic development in the use of mobile learning environments according to students' needs.

ITEM SELECTION

Three types of items are represented in version 1.0 of the Mobile Learning Scale:

- The first 3 items address perceptions of mobile learning devices and tools (Apps) for informal learning.
- The last 3 items address feelings about using theories and models to incorporate mobile learning into higher education.
- The 4th item addresses perceived student acceptance of mobile learning.

These items are grounded in the need for recognizing both formal and informal learning in the 21st century educational environment (Lai, 2011; Cox, 2012), and were developed by taking the major summary bullet points from discussions among the 135 researchers, policy makers, and association leaders from 41 nations attending EduSummIT 2011 (Knezek, Lai, & Khaddage, 2011). Item stems were paired with five-point (strongly disagree to strongly agree) Likert-type rating categories, and pertinent demographic items were also included. Each attitudinal item is worded as a judgment, in the manner that judgment tasks are normally defined in psychometric scaling methods (Dunn-Rankin, Knezek, Wallace, & Zhang, 2004). In this technique, respondents are asked to give their views of what is true in the world at large rather than what is currently true for they themselves. Thus, the items are not designed to record ratings but rather judgments or beliefs, the latter of which scholars such as Ertmer (2005) regard as the final frontier in the quest for fully integrating technology into teaching and learning. A copy of version 1.0 of the Mobile Learning Scale instrument is provided in the Appendix.

DATA SOURCES

The Mobile Learning Scale was administered to 81 undergraduate and graduate students at a large Midwestern university in the USA during August and September of 2011. Of these students, 68 were undergraduates attending one of three sections of a technology integration course for teacher preparation candidates at the beginning of their teacher preparation course sequence. Most were in their second or third year in the university. The remaining subjects were students enrolled in summer doctoral research and data analysis courses.

As shown in Table 1, on a scale of 1 = strongly disagree to 5 = strongly agree, those completing the survey tended to agree most strongly with item M3, Mobile Apps could bring enormous opportunities into universities to further empower informal learning. This outcome indicates that students view mobile Apps as a method for enhancing informal learning, since learning via mobile Apps is seen by students as an engaging experience. Therefore, it is paramount to implement a mobile learning system that respects the importance of informal learning.

University students tended to agree least strongly with item M7, The integration of mobile Apps, mobile social networking platforms and other mobile technologies has become pervasive in teaching and learning. This outcome indicates that students perceive there is a need for further development by universities in this area. Note that the group mean score for this item was 3.95 on a scale of 1 (strongly disagree) to 5 (strongly agree). The mean rating of approximately 4 = agree on this item indicates the group as a whole actually "agrees" that mobile technology integration has become pervasive in teaching and learning, but they also perceive there is room for further development.

Table 1: Descriptive statistics for Mobile Learning Scale items

Item	Mean (n = 81)	Std. Deviation
M1	4.23	.531
M2	4.09	.656
M3	4.33	.632
M4	4.26	.721
M5	4.17	.685
M6	3.98	.689
M7	3.95	.835

RELIABILITY

The program SPSS (Statistical Package for the Social Sciences) was used to compute internal consistency reliability estimates for the scale. As shown in Table 2, Cronbach's Alpha was .85 for this set of subjects completing the survey. This is in the range of "very good" according to the guidelines provided by DeVellis (1991), as listed in Table 3.

Table 2: Internal consistency reliability for the Mobile Learning Scale

Reliability Statistics	
Cronbach's Alpha	N of Items
.847	7

Table 3: Descriptive statistics for Mobile Learning Scale items

Below .60	Unacceptable
Between .60 and .65	Undesirable
Between .65 and .70	Minimally acceptable
Between .70 and .80	Respectable
Between .80 and .90	Very good
Much above .90	Excellent (Consider shortening the scale)

As shown in the third column of Table 4, values for the correlations between each item and a scale score produced from the remainder of the items (corrected item-total correlations) were all non-negative and reasonably high. This information,

when combined with the values shown in fifth column of Table 4, indicates there are no obviously weak items, those whose deletion would noticeably strengthen Cronbach's Alpha for those retained.

Table 4: Item-total statistics for Mobile Learning Scale

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
M1	24.78	9.850	.542	.836
M2	24.93	8.769	.705	.811
M3	24.68	8.971	.677	.816
M4	24.75	9.288	.485	.844
M5	24.84	9.061	.583	.829
M6	25.04	8.586	.713	.809
M7	25.06	8.434	.578	.834

DISCUSSION

Reliability – or measurement consistency – is one important attribute of an attitudinal survey, but validity, which is concerned with appropriateness or relevance, is also important. Content validity for the Mobile Learning Scale is believed to be high for the two targeted areas of learner perceptions of mobile devices and applications (Apps), and ways in which they can contribute to informal learning. This is because the instrument was created by directly converting relevant bullet point findings from EDUSummIT 2011 into survey items while also using previously developed parameters for mobile learning prospects (Khaddage & Knezek, 2011) as a guide. Therefore the Mobile Learning Scale version 1.0 items are believed to represent the current collective thinking of ICT educators from around the world.

There is also sound theoretical rationale for instruments such as the Mobile Learning Scale (MLS) presented in this paper. Bandura (1997, 2006) in his social cognitive theory about self-efficacy stated that self-efficacy is concerned with the belief in one's ability to succeed under certain circumstances or in a new environment. Basically, it determines how individuals see themselves, and measures judgments of their capabilities. The Mobile Learning Scale (MLS) relates to Bandura's theory of self-judgment within a mobile learning environment, in that students were presented with seven items, and they were asked to rate their belief/acceptance/level of agreement with their abilities regarding whether they can perform certain tasks with mobile technologies and applications. As shown in Table 1, students were asked to rate on a scale of 1 = strongly disagree to 5 = strongly agree, and this rating was completed individually according to each student's judgment of ability to use or accept the new technology. Bandura (2006) also insisted that the need for items with similar elements within a certain domain-relevant scale is crucial. Cronbach's alpha was .85 for this study (see Table 2), indicating that the MLS could be considered consistent and strong.

Future research is planned to examine the construct and criterion-related validity of the Mobile Learning Scale. Preliminary indications are that when used as a total scale score, the criterion-related validity of the Mobile Learning Scale version 1.0 will be good. In particular, among the 81 graduate and undergraduates providing the data used to assess the internal consistency reliability of the instrument for this group of subjects, significant ($p < .01$) correlations were found between Mobile

Learning Total Scale Score and a general Semantic Perception of Technology also administered to these students (r = .35, p = .005). In a 2012 administration of the Mobile Learning Scale version 1.0 as part of a battery of technology attitude instruments to a Midwestern USA online learning community, female respondents (n = 112, mean = 3.26, Std. = .43) were found to be more positive in their mobile learning attitudes (p < .02) than male respondents (n = 35, mean = 3.05, Std. = .41). The effect size (Cohen's d) for gender for this group was ES = .49, which would be considered moderate according to the guidelines provided by Cohen (1988) and well beyond the ES = .3 criterion at which the magnitude of group differences is often considered educationally meaningful (Bialo & Sivin-Kachala, 1996). Furthermore, among these same respondents, the correlation of Mobile Learning Scale version 1.0 total scale score and a Likert-type measure of self-reported creative tendencies was found to be positive (r = .25) and significant (p < .01). This latter finding is the beginning of evidence suggested as needed by Cox (2012), that use of the newer learning technologies is positively associated with innovative ways of teaching and learning. Further research is needed in this area.

Feedback received by the authors at WERA 2011 indicated that additional items in the area of student perceptions of mobile learning might be warranted, for example, in order to enhance the ability of the Mobile Learning Scale to record student perceptions as an individual construct. Development of version 2.0 of the instrument has begun by the authors in response to these and other suggestions.

Currently there is a well-recognized need to establish baseline measures for various learning clientele groups with respect to their attitudes toward mobile learning applications, as well as toward information and communication technologies in general. It appears that version 1.0 would be appropriate for establishing baseline measures for different genders or age groups, as well as different nations or cultures. Mobile technologies are being developed on a daily basis, and university students are pushing these technologies into the classroom environment (Stead, 2005; Khaddage, Lanham, & Zhou, 2009). Arguments have been made that these information and communication technologies (ICTs) are becoming an integral part of teaching and learning environments. For example, Knezek (2010) described teaching and learning without the latest technologies as similar to practicing medical professions without technology, in that these professions cannot be performed accurately and efficiently without technology today. In certain circumstances, if the technology is lacking, then necessary procedures cannot be carried out at all (Knezek, 2010). Mobile tools and applications may be seen as fusion technologies that are capable of shifting the learning environment to a new, dynamic, flexible, collaborative and portable context. For a decade now there has been a global demand towards the integration of mobile technologies into teaching and learning (Belt, 2001; Tatar & Roshelle, 2003; Attewell, 2005; Khaddage et al., 2009; Sharples, Taylor, & Vavoula, 2010; Khaddage & Knezek, 2011).

CONCLUSION

Analysis of data gathered from 81 undergraduate and graduate university students indicates that the seven-item Mobile Learning Scale version 1.0 has good internal consistency reliability (Cronbach's Alpha = .85) and is capable of measuring attitudes toward mobile learning in university students. This sets the stage for comparing and contrasting attitudes found in a wide range of disaggregated learner groups, such as graduate versus undergraduate students, males versus females, and students from two or more different countries. The authors contend that the potential applications of mobile technologies to teaching and learning are virtually boundless, primarily because mobile devices are now very common amongst students, and the mobile phone in particular is the most commonly used device by the majority of students (Wajcman, Bittman, Jones, Johnstone, & Brown, 2007). Mobile applications (Apps) are becoming the new method and the latest trend for access-

ing learning and acquiring information anytime and anywhere (Khaddage, Lattemann, & Bray, 2011). The Mobile Learning Scale version 1.0 offers a tool for assessing student attitudes toward this new technology across disaggregated user groups, and within groups, over time.

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Appendix: Mobile Learning Scale

Instructions: This survey contains a demographics section and 12 brief items. Please read each statement and then mark the circle which best shows how you feel.

Gender: ①Male ② Female

Age: ①< 21 ② 21=30 ③31-40 ④ 41-50 ⑤ 51-60 ⑥> 60

Do you have a computer at home? ①No ② Yes

Do you have access to the Internet at home? ①No ② Yes

How many hours per week do you spend on your computer (including Internet) at home?

①0 hours per week ③1-4 hours per week
②5-10 hours per week ④More than 10 hours per week

Do you own a Smartphone? ①No ② Yes

How many hours per week do you use your Smartphone (voice, data, Apps combined)?

①0 hours per week ③1-4 hours per week
②5-10 hours per week ④More than 10 hours per week

Instructions:Select one level of agreement for each statement to indicate how you feel.
SD = Strongly Disagree**, D =** Disagree, **U =** Undecided**, A =** Agree**, SA =** Strongly Agree

		SD	D	U	A	SA
1.	The rapid development of Mobile Learning devices and tools (Apps) has empowered informal learning.	①	②	③	④	⑤
2.	Mobile Apps could be integrated seamlessly to support informal learning.	①	②	③	④	⑤
3.	Mobile Apps could bring enormous opportunities into universities to further empower informal learning	①	②	③	④	⑤
4.	Student acceptance of Mobile Learning in higher education would be high.	①	②	③	④	⑤
5.	Recent developments in Mobile Learning are leading to the exploration of new methods/models at universities	①	②	③	④	⑤
6.	Theoretical models and methods can assist in informing the design for mobile learning Apps	①	②	③	④	⑤
7.	The integration of mobile applications, mobile social networking platforms and other mobile technologies has become pervasive in teaching and learning.	①	②	③	④	⑤

Thank you for your time. MLS v1.0 8/2011 by Khaddage & Knezek.

Biographies

Dr. Ferial Khaddage is lecturer/researcher at Deakin University, Melbourne Australia. Her primary research interest is mobile learning technologies and applications in education and has published widely in the area. She is an active member of the Association for the Advancement of Computers in Education (AACE) and a founder and executive committee member of Global Learn Asia Pacific, a Global Conference on Learning and Technology.

Prof. Gerald Knezek is Regents Professor of Learning Technologies at the University of North Texas and Director of the Institute for the Integration of Technology into Teaching & Learning at UNT. He is currently Lead Principal Investigator for the US National Science Foundation Innovative Technologies Project Middle Schoolers Out to Save the World (MSOSW), and was Co-Principal Investigator for a US Fund for Improvement for Post-Secondary Education project titled sim Mentoring.