

Mobile Learning (m-learning): Current Research and Assessment Methods

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NOTE: this packet was primarily created for faculty experimenting with mobile learning in the context of a course, but also contains generalized resources for those interested in mobile learning.

Introduction

This document is meant to serve as a starting point for researchers interested in developing, implementing and/or assessing the use of mobile devices for educational purposes. In most literature, mobile learning refers to learning with small-size (usually handheld) electric devices (e.g., mobile phones, smart phones, personal digital assistants, etc). The table of contents below will guide you to each section. If you have any questions or comments, please email them to Bart Pursel (pursel@psu.edu).

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Current Research

As mobile devices, particularly smart phones, are proliferating college campuses, new opportunities to leverage these devices for learning have emerged. Several university surveys, such as those conducted by [Ball State's Institute for Mobile Media Research](#) and [Penn State University's FACAC survey](#), show that over 90% of students possess a mobile communication device. Not all of these devices are smart phones, but smart phone adoption is growing rapidly as prices continue to decrease. With the rapid adoption of smart phones, this is an ideal time to examine the current state of research exploring the application of smart phones in teaching and learning.

In a review of mobile learning projects, Frohberg, Göth and Schwabe (2009) found that mobile devices were used as a tool for different purposes in education including content delivery, interaction for motivation and control, guided reflection, reflective data collection, and content construction. Cheung and Hew (2009) had a somewhat different typology in their review. They categorized six different uses of mobile devices in education and learning, namely multi-media access tools, communication tools, capture tools, representational tools, analytical tools, and assessment tools. Other researchers also summarized the use of specific mobile devices in education (e.g., Cobcroft, Towers, Smith, & Bruns, 2006; Naismith, Lonsdale, Vavoula, & Sharples, 2006). A short summary of these key articles is presented below.

Meta Analysis and Review

(Cobcroft, Towers, Smith, & Bruns, 2006) Based on 400 recent publications related to mobile learning, this article reviewed 1) areas of M-learning design and development; 2) major learning theories/paradigms and how mobile learning fits into those theories; 3) Different types of mobile devices and their typical use for learning; and 4) Bibliography information including key contributors, journals, conferences, and projects.

(Naismith, Lonsdale, Vavoula, & Sharples 2006) This review identified different types of mobile technologies applicable to learning, emerging practices of mobile learning and their learning theory backgrounds. In addition, the authors offered implications and guidelines for current and future mobile learning.

(Cheung and Hew 2009) This article reviewed the methodologies used in the studies on mobile learning with handheld devices. Specifically, the review covered different uses for handheld devices in education, research designs, and research topics.

(Frohberg, Göth & Schwabe, 2009) This article summarized and evaluated 102 mobile learning projects prior to 2007. The evaluation criteria included context, tools, control, communication, subject and objective.

Assessment Research

Based on Cheung and Hew's (2009) review, the assessment research of m-learning has three foci:

- 1) assessing mobile-devices as an assessment tool
- 2) assessing the learning outcomes of m-learning
- 3) assessing learners' attitudes towards m-learning

The design used in these assessments include descriptive research, between-subject experiment (treatment vs. control groups), within-subject experiment (i.e., pre- and post-intervention design), quasi-experiment (i.e., control for some variables in the comparison, but with no randomization), and mixed methods. Data were collected using different approaches including project related documents, test/quiz, questionnaire, interview, observation, and focus groups.

Example Studies

Assessment of mobile-devices as an assessment tool

(Segall et al., 2005) Using an experiment, this study compared a PDA-based quiz and a paper-and-pencil quiz in terms of quiz effectiveness (quiz score), efficiency (completion time), and satisfaction. The results showed the PDA-based quiz to be more efficient. No differences, however, were found in effectiveness and satisfaction between the two quiz types.

Assessment of learning outcomes

(Zurita and Nussbaumw 2004) This research assessed the effectiveness of mobile device in children's Spanish learning. An experiment design (m-learning group vs. traditional learning group) was employed. The results indicated that m-learning yielded better learning outcomes (measured by language tests) and more constructive learning activities (supported by the observation).

Assessment of attitude toward m-learning/mobile device

(Chen and Chung 2008) This study assessed the effectiveness of mobile devices in improving Taiwanese students' English learning. In addition, this study evaluated students' attitudes towards using mobile devices for English learning. A within-subject experiment was employed (i.e., pre and post test design). The results showed that m-learning is capable of promoting students' English learning and interest. In addition, the mobile device was rated positively by most students.

Variables of Interest

Mobile devices are believed to offer some unique benefits to learning. These benefits, often the foci of many m-learning research, includes flexibility, accommodating special needs of some learners, improving learners' engagement and motivation, encouraging learners' critical thinking and construction of knowledge, and facilitating the communication and collaboration between learners. However, in many cases these benefits were supported by qualitative observation, project documents (e.g., written comments) or researchers' assumptions. For example, Zurita and Nussbaum (2004) observed that m-learning results in more interaction and collaboration than traditional learning. Based on the observation notes and audio transcripts, Hennessy (2000) found that students in m-learning were engaged in active and reflective learning. The following table focuses on quantitative measures, predominantly scales that other researchers used in the past.

Variables	Citations	Notes
Test score and performance	Segall et al., 2005; Treadwell, 2006; Chen & Chung, 2008; Chen et al., 2003; Thornton & Houser, 2005; Zurita & Nussbaum, 2004; Hennessy, 2000; Kong & Li, 2007; Tan et al. 2007	Test performance has been used by many studies assessing the effectiveness of m-learning. These course-based tests are often designed in an open-ended format (e.g., multiple choices question).
Memory retention of knowledge	(Chen & Chung, 2008)	Illustrates how a PDA-based learning module for language acquisition overcomes space and time boundaries to allow learning to take place in a more flexible way (no space or time boundaries). Leverages Item Response Theory.
Time for preparing and completing the assessment	Segall et al., 2005; Treadwell, 2006	Time for preparing and completing the assessment is used by researchers studying the use of mobile device as an assessment tool (e.g., distributing quizzes)
Attitude and Satisfaction	Ganger & Jackson, 2003; Segall et al., 2005; Treadwell,	Many studies assessed learners' overall and specific

	2006; Triantafillou et al., 2008; Chen & Chung, 2008; Chen, Hsieh, & Hsu, 2007; Thornton & Houser, 2005	attitude towards the m-learning or mobile devices (e.g., ease of use, learning benefits)
Computer Anxiety	Segall et al. 2005	Segall et al. 2005 measured learners' computer anxiety level based on Loyd and Gressard's (1984) scale and assess the relationship between computer anxiety level and students' attitude toward using m-device for assessment
Self-assessment of learning/perceived learning	Chen & Chung, 2008; Levy & Kennedy, 2005	Both studies primarily focus on language acquisition that takes place on, or assisted by, mobile devices.

Research Instruments

Below is a sampling of research instruments that have been applied to mobile learning studies. The primary focus of the instruments includes attitudes of mobile learning, user interface satisfaction and the use of mobile devices for the assessment of learning.

Thornton & Houser(2005) attitude survey of mlearning

Overall Evaluation of Mobile Device

- Wonderful (0=terrible, 9=wonderful)
- The system was easy to use (0=difficult, 9=very easy)
- Satisfying (0=frustrating, 9=very satisfying)
- Interesting (0=boring, 9=very interesting)

Screen (0=disagree; 9=agree)

- Text was easy to read
- Videos were clear
- It was easy to navigate between pages
- Information was clearly organized
- The sequence of screens was easy to understand
- The use of color was clear

Sound (0=disagree; 9=agree)

- The sound was very clear

Instructions (0=disagree; 9=agree)

- I easily knew what to do

Learning (0=disagree; 9=agree)

- This software will help me learn English idioms
- I can remember all the English idioms I studied using this software
- Overall, this software is good for studying English idioms
- Mobile phones/PDA are good for studying vocabulary
- Mobile phones/PDA are good for practicing listening
- Mobile phones/PDA are good for watching videos in English

Chen & Chung (2008) attitude survey of mlearning

(1= Strongly agreed; 2=Agreed 3= No opinion; 4=Disagreed 5=Strongly disagreed)

System operation

- I think that the mobile English vocabulary learning system provides a friendly user interface
- I am very clear about the learning procedure of the mobile English vocabulary learning system
- I can completely understand the meaning of learning materials that appears on the mobile English vocabulary learning system
- I think the mobile English vocabulary learning system is a good learning tool to assist English learning
- I agree that learning English by PDA is very convenient; because I can perform English learning at any time and place

Learning attitude

- The design learning materials on the mobile English vocabulary learning system can promote my learning interests
- I often increase my learning time because learning by the proposed mobile English vocabulary learning system promotes my learning interests
- I think that using the mobile English vocabulary learning system can effectively promote my English vocabulary ability
- The self-inspection interface of the mobile English vocabulary learning system can prompt my learning motivation

- I agree that using PDA to learn English vocabulary is a very interesting learning mode
- After learning some vocabulary, a cloze test immediately given from the proposed system for the learned vocabulary is very helpful to test whether I have memorized the English vocabulary
- The review strategy of English vocabulary is very effective to me

(5 = strongly agree, 3 = neutral, 1 = strongly disagree)

- MLS was useful for the existing course
- MLS was a good discussion tool
- MLS was easy to use
- MLS was easy to understand
- MLS had a good forum for interaction
- MLS was easy to discuss course material w/other students
- MLS was easy to discuss course material w/the instructor
- MLS was a convenient platform to access course discussions
- MLS has potential to become good learning tool
- MLS adds value to e-learning
- MLS allows instant access regardless of your location.
- MLS is useful to supplement to an existing course
- MLS is an effective learning aid or assistant for students
- MLS is an effective method of providing personalized information
- MLS allows to convert any wait (dead) time into productive
- MLS allows convenient access to discussions – anywhere and anytime
- MLS that sends the information via messages may be better
- MLS that also allows access to information from the website
- MLS can be used as a supplemental tool for any existing course
- Overall satisfaction with MLS

Chin, Diehl, Norman (1988) user interface satisfaction

Overall reactions to the software

Terrible					Wonderful				
0	1	2	3	4	5	6	7	8	9

Difficult					Easy				
0	1	2	3	4	5	6	7	8	9

Frustrating					Satisfying				
0	1	2	3	4	5	6	7	8	9

Inadequate power					Adequate power				
0	1	2	3	4	5	6	7	8	9

Dull					Stimulating				
0	1	2	3	4	5	6	7	8	9

Rigid					Flexible				
0	1	2	3	4	5	6	7	8	9

Screen

Characters on the computer screen

hard to read					easy to read				
0	1	2	3	4	5	6	7	8	9

Highlighting on the screen simplifies task

not at all					very much				
0	1	2	3	4	5	6	7	8	9

Organization of information on screen

confusing					very clear				
0	1	2	3	4	5	6	7	8	9

Sequence of screens

confusing					very clear				
0	1	2	3	4	5	6	7	8	9

Terminology and system information

Use of terms throughout system

inconsistent					consistent				
0	1	2	3	4	5	6	7	8	9

Computer terminology is related to the task you are doing

never					always				
0	1	2	3	4	5	6	7	8	9

Position of messages on screen

inconsistent					consistent				
0	1	2	3	4	5	6	7	8	9

Messages on screen which prompt user for input

confusing					clear				
0	1	2	3	4	5	6	7	8	9

Computer keeps you informed about what it is doing

never					always				
0	1	2	3	4	5	6	7	8	9

Error messages

unhelpful					helpful				
0	1	2	3	4	5	6	7	8	9

Learning

Learning to operate the system

difficult					easy				
0	1	2	3	4	5	6	7	8	9

Exploring new features by trial and error

difficult					easy				
0	1	2	3	4	5	6	7	8	9

Remembering names and use of commands

difficult					easy				
0	1	2	3	4	5	6	7	8	9

Tasks can be performed in a straight-forward manner

never					always				
0	1	2	3	4	5	6	7	8	9

Help messages on the screen

unhelpful					helpful				
0	1	2	3	4	5	6	7	8	9

Supplemental reference materials

confusing					clear				
0	1	2	3	4	5	6	7	8	9

System capabilities

System speed

too slow					fast enough				
0	1	2	3	4	5	6	7	8	9

System reliability

unreliable					reliable				
0	1	2	3	4	5	6	7	8	9

System tends to be

noisy					quiet				
0	1	2	3	4	5	6	7	8	9

Correcting your mistakes

difficult					easy				
0	1	2	3	4	5	6	7	8	9

Experienced and inexperienced users' needs are taken into consideration

never					always				
0	1	2	3	4	5	6	7	8	9

Ganger & Jackson(2003) attitude of mobile devices for assessment

(1=Strongly agree; 2= Agree; 3=Neither agree nor disagree; 4=Disagree; 5=Strongly disagree)

- Log-in process was easy
- Exam navigation was easy
- Viewing text and images on the small screen was easy
- Paper and pencil exams are prefer-able
- Computer-based exams using a desktop PC are preferable
- Proctoring console was a distraction
- Browser lock-down function was a distraction

Chen & Chung (2008) Self assessment of learning

This question aims at self-assessing your vocabulary ability. Please use the notations Δ and \square to indicate your vocabulary abilities based on the following ability scale before and after using this mobile English vocabulary learning system, respectively.

0 1 2 3 4 5 6 7 8 9 10

Key Journals and Conferences

British Journal of Education Technology
Communications of the ACM
Computers and Education
Computer Science Education
Educational Research & Evaluation
EDUCAUSE Quarterly,
EDUCAUSE Review
Interactive Learning Environments
International Journal of Artificial Intelligence in Education
International Journal of Human-Computer Interaction
Issues in Informing Science and Information Technology
Journal of Computer Assisted Learning
Journal of Educational Multimedia and Hypermedia
Personal and Ubiquitous Computing Journal

ASCILITE: Australian Society for Computers in Learning in Tertiary Education:
<http://www.ascilite.org.au/>

IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE):
<http://ltf.ieee.org/wmte2005/>

IEEE International Conference on Pervasive Computing and Communications (PerCom):
<http://www.percom.org/>

JISC Online Conference: Innovating e-Learning:
http://www.jisc.ac.uk/elp_conference06.html

M-Learn: <http://www.mlearn2006.org/>

IADIS International Conference on Mobile Learning:
<http://www.iadis.org/ml2006/>

Penn State Specific Resources

Education Technology Services (ETS) – ETS is part of Teaching and Learning with Technology, and has some experience in leveraging mobile devices for education. Specifically, the Educational Gaming Commons (<http://gaming.psu.edu>) is looking at ways to integrate mobile gaming and learning.

The Schreyer Institute for Teaching Excellence (SITE) – The Schreyer Institute provided funding in the form of a Teaching Support Grant to several faculty to create mobile learning applications as part of a course experience. You can contact the institute (site@psu.edu) if you're interested in additional details or a description of past projects.

Classroom and Lab Computing (CLC) – CLC is currently (spring 2011) piloting two clicker systems to replace PSU's old system (<http://clc.its.psu.edu/Classrooms/resources/clickers>). While clickers differ from the use of cell phones as learning devices, some of the methods used to study the impact of mobile devices on learning can also be used to study the impact of clickers.

External Resources

Poll Everywhere (<http://www.polleverywhere.com/>) – This online, web-based service allows an instructor (or anyone) to create surveys, polls and other data collection methods that can be shared with students. Students then use a mobile device to text an answer or select a response to a pre-determined phone number. The results can be displayed in real time via the Poll Everywhere website. The site offers limited free accounts and several levels of paid accounts.

Wiffiti (<http://wiffiti.com/>) – This is something akin to an online bulletin board, accessible via texting. An instructor can produce a bulletin board using Wiffiti, and then ask students to text a response to a prompt around the content. The messages then begin to appear, in real time, on the Wiffiti bulletin board. The bulletin board can be projected and allows for students to see peer feedback in real time.

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