

## **Effectiveness and Acceptance of Mobile Learning**

Paul W. Williams  
Information Systems and Technology Management  
George Washington University

Mary J. Granger  
Information Systems and Technology Management  
George Washington University  
granger@gwu.edu

### **Abstract**

Mobile Learning (M-Learning) is no longer a novelty. Thousands of post-secondary education institutions and millions of workforce and distance-education students worldwide consider M-Learning a mainstream, pervasive, learning delivery mode. It is a different and alternate approach to Face-to-Face, Distance Learning (D-Learning), and Electronic Learning (E-Learning). A gap exists in the literature regarding the effectiveness of M-Learning. It is important to evaluate this learning delivery mode against Face-to-Face learning. This study examines M-Learning effectiveness vis-à-vis Face-to-Face and investigates the extent to which students accept the delivery of learning conducted through this new paradigm. A quasi-experimental research design is proposed to determine the impact of M-Learning on student performance and to uncover factors that influence user acceptance of M-Learning.

**Keywords:** mobile learning, Face-to-Face learning, UTAUT, media comparison studies

## Effectiveness and Acceptance Of Mobile Learning

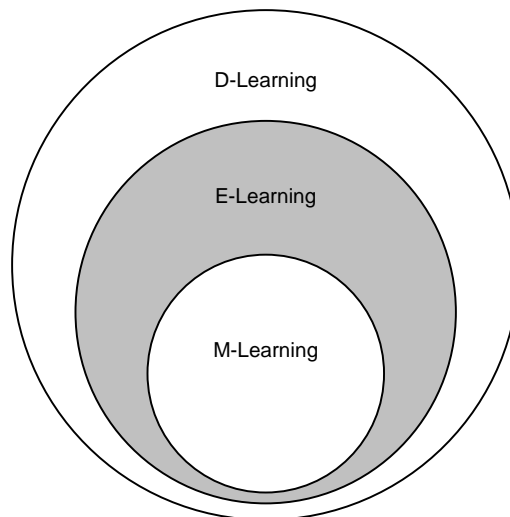
### I. INTRODUCTION

The purpose of this study is to examine the effectiveness of an alternate, Mobile Learning (M-Learning) delivery mode vis-à-vis the Face- to-Face learning delivery mode and to determine the extent to which students accept M-Learning. A gap exists in the literature regarding the effectiveness of M-Learning. This study is important because it will fill this literature gap using a comparison of the effectiveness of M-Learning paradigm versus Face-to-Face. Although many M-Learning projects exist, there is a dearth of media comparison studies [WCET 2008, Russell 2001].

M-Learning is no longer a novelty. It is a mainstream, pervasive learning delivery mode relied upon by thousands of post-secondary education institutions and millions of workforce and distance-educated students worldwide [U.S. Department of Education, 2002]. M-Learning is a different and alternate approach to D-Learning and E-Learning (Figure 1). M-Learning:

- 1) provides the ability to create homogenous learning objects for heterogeneous mobile devices,
- 2) uses wireless connectivity.

It creates an environment of anywhere, anytime learning [Cobcroft, et al., 2004; Hollis, 2004; Wagner, 2007].



**Figure 1 The Place of M-Learning in relation to E- and D-Learning**

**[Georgiev, et al., 2004]**

M-Learning research and development efforts continue to move rapidly; ostensibly to keep pace with mobile learner demand for multimedia, wirelessly-delivered learning objects viewable at a time and place convenient to them. Some popular devices that meet these requirements are iPods, mobile phones, smart phones and other small information appliances [W3 Consortium].

We are undergoing an explosion of M-Learning as a learning mode. The explosion is driven by a mobile workforce and enabled by technologies. However, the question remains as to whether M-Learning is as effective as Face-to-Face – which remains the yardstick against which all other learning strategies are measured.

It is important to evaluate any new learning paradigm against Face-to-Face. This research addresses the following questions:

1. Is M-Learning equal to or more effective than Face-to-Face?
2. What are the factors that influence the acceptance of M-Learning?

Beneficiaries of the study are instructors, as well as trainers in the private sector and workforces. As each constituency ponders the implementation of M-Learning projects, they should evaluate the effectiveness of M-Learning, its profitability and return on investment [Traxler, 2001].

The M-Learning delivery method seems to overcome the initial hype and the competitive challenge from Face-to-Face, and establishes itself as a viable contender in the instructional delivery arena. It continues to develop at a rapid clip, utilizing wireless media and is gaining acceptance by millions of users and hundreds of institutions [Apple Computer Corporation, 2007]. It has become a learning object delivery reality which encourages learners who use ubiquitous mobile devices to attend virtual courses and/or wish to supplement Face-to-Face.

Will M-Learning become another contribution to Russell's body of research where a 'No Significant Difference Phenomenon' (NSD) exists [Russell, 2001]? One where:

. . . [the] amount of learning produced by different media is similar (NSD) but adequate to meet our instructional goals, [where] all treatments are equally valuable for learning but . . . usually differ in their cost and convenience [Russell, 2001, x].

This would indicate that M-Learning might be no more or less effective than Face-to-Face.

## Background

Many competing models designed to account for IT user acceptance have been researched, designed, and implemented [Venkatesh et al., 2003]. Drawing on “. . . robust theories from social psychology, notably the theory of reasoned action (TRA), the theory of planned behavior (TPB), diffusion of innovations (DOI) theory, and social cognitive theory (SCT)” [Agarwal, 2000]. Venkatesh, et al. [2003] designed the UTAUT model after they noted that researchers typically pick and choose constructs across underlying acceptance models. Alternately, researchers take all constructs from a favorite model. Venkatesh, et al. [2003] observed that the latter procedure causes researchers to ignore the contributions from alternative models. They determined a need to review and synthesize the prominent models in order to “. . . progress toward a unified view of user acceptance. As they noted these deficiencies in the implementation of underlying acceptance models, Venkatesh, et al. synthesized eight of the most popular models - representing fields as diverse as information systems, psychology, and sociology – into the UTAUT model.

The original Venkatesh, et al. model included Age as a moderator. The target population for the study (sophomore students) presents a relatively homogenous age distribution and was eliminated from inclusion in the research model. The remainder of the original Venkatesh model remains intact with the exception of: 1) the addition of Mode of Delivery as a moderator, and 2) the inclusion of Performance as an outcome variable.

Mode of Delivery was added to understand the impact M-Learning has on student performance. This dichotomous variable comprises M-Learning and FACE-TO-FACE values and is a vital component of the study – without this variable, it would be impossible to understand the impact one learning mode has over the other.

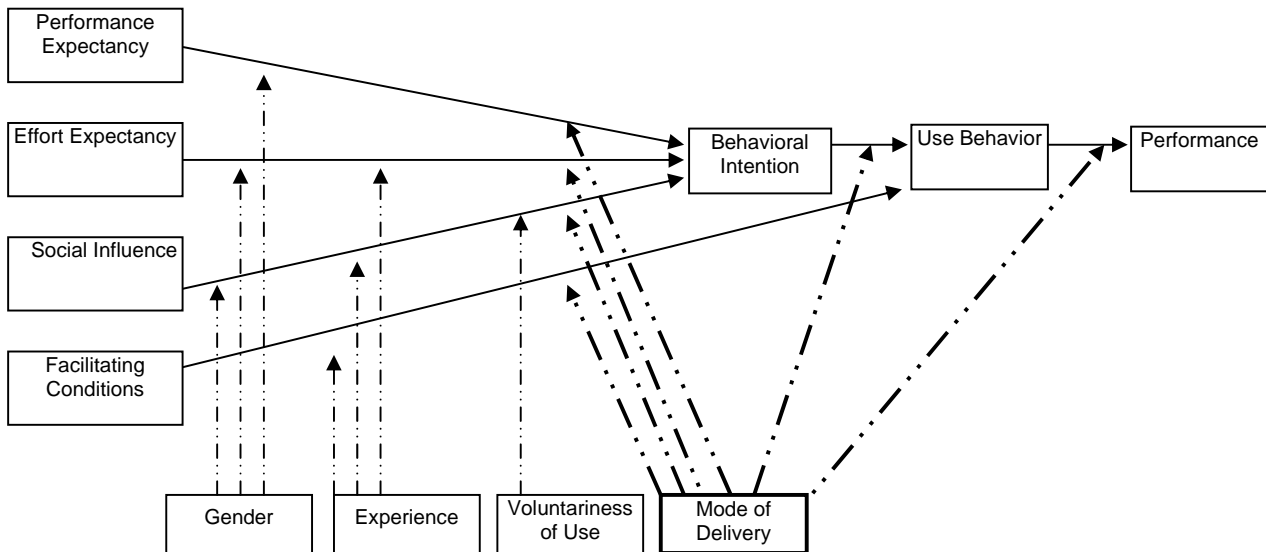
Performance, the operationalization of Effectiveness in this research, was included as an additional outcome variable to address Research Question 1 (M-Learning effectiveness). The addition of Performance as an outcome variable to a Technology Acceptance Model is consistent with the research of Dasgupta, et al. [2002].

*Gender* is included as moderator by Venkatesh, et al. because “Research on gender differences indicates that men tend to be highly task-oriented [Minton and Schneider, 1980] and, therefore, performance

expectancies, which focus on task accomplishment, are likely to be especially salient to men.”[Venkatesh et al., 2003].

Drawing from the arguments made in the context of performance expectancy [Levy, 1988], Venkatesh, et al. expected to see Gender, Age, and *Experience* work in concert. *Voluntariness of Use*, “. . . the degree to which use of the innovation is perceived as being voluntary, or of free will” [Moore and Benbasat, 1991, p. 195] was measured as a manipulation check where 1 was nonvoluntary and 7 was completely voluntary.

After a review of the literature, a model was developed and used in the research.



**Figure 2 - Research Model [Adapted From Venkatesh et al., 2003; Dasgupta et al., 2002]**

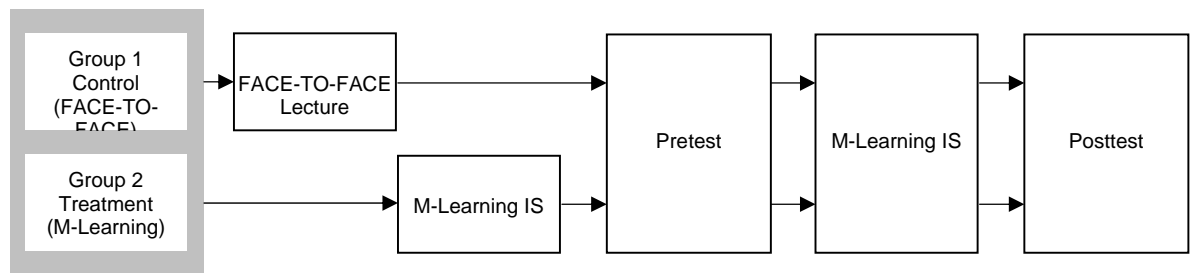
### Research Questions

The first research question addresses the impact of M-Learning on student performance. This will be measured by the variance in pre-test and post-test scores of control (Face-to-Face) and treatment (M-Learning) groups on two instructor-proctored, in-class quizzes.

The second research question addresses the factors that influence user acceptance of M-Learning. This will be measured using the Unified Theory of acceptance and Use of Technology (UTAUT)[Venkatesh et al., 2003].

## II METHODOLOGY

This study is a quasi-experimental, nonequivalent control group research design with Control (Face-to-Face) and Treatment (M-Learning) populations. The control group receives a Face-to-Face lecture, while the treatment group has unlimited access to a M-Learning MP3 file recording of the Face-to-Face lecture. After the Face-to-Face lecture, the control group will take a pretest (Quiz 1); after a week of unlimited access to the MP3 file, the treatment group will take a pretest (Quiz 1). Both groups will then have unlimited access to the MP3 file for one week. After the week, both groups will take a posttest (Quiz 2).



**Figure 3 Study Methodology [Investigators]**

Seven sections of an undergraduate Information Systems required core course participated in the study. Course sections are paired – one Control and one Treatment group per pair. The remaining section is randomly assigned to a Control or Treatment group.

Research question 1 is addressed at T2 after Test1 has been administered. Observable differences in student performance as measured by grades across Control and Treatment groups within a section will be used to assess M-Learning effectiveness. Research question 2 is addressed at T3 through administration of a UTAUT survey [Appendix 1], a demographics questionnaire, and a self-reported M-Learning usage log. There is no way to confirm actual usage of the M-Learning file. The MP3 file will be hosted on an electronic course content management system familiar to all participants, and the number of times a student access the file is available, but it does not confirm actual listening to the lecture.

### Data Collection

Survey data from the questionnaire, survey, and quizzes are collected by the investigator. The investigator is the primary coder, and is responsible for assessing coding consistencies, scale reliability, anomalies, and for identifying outliers. Data security and subject privacy is protected through data separation and maintenance procedures. The demographic data collected through questionnaires that could be used to identify individual students is maintained separately from survey and test data. In turn, survey data are maintained separately from test results.

### Threats to Validity

Although the nonequivalent control group design does not offer the same level of immunity to internal and external validity threats as a true experiment, Campbell and Stanley [1963] note that this is one of the stronger quasi-experimental designs. There are two possible threats to internal validity: regression to the mean, and the interaction of selection and maturation. In addition, three potential threats to the external validity of the study possibly limited its generalizability. These are: interaction of testing and treatment, interaction of selection and treatment, and reactive arrangements.

## III. DISCUSSION

Many universities are implementing technologies that allow students to access course materials on wireless devices. Class lectures are taped and made available to students who wish to repeat the lecture any number of times. These lectures are provided in a format that is compatible with many heterogeneous mobile devices, giving rise to M-Learning.

This study will look at the effectiveness of M-Learning compared to traditional, Face-to-Face learning. Additionally, this research will evaluate usage of M-Learning, following Venkatesh et al's [2003] Unified Theory of Acceptance and Use of Technology model. This will be an attempt to determine if the technology is actually being used and at what rate. The major contribution to the literature may be the

result of the application of technology acceptance theory to M-Learning. Therefore, this study will have some practical applications, and may also add to Information Systems theory.

#### IV. REFERENCES

*Editor's Note:* The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that

1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
2. the contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. the author(s) of the Web pages, not AIS, is (are) responsible for the accuracy of their content.
4. the author(s) of this article, not AIS, is (are) responsible for the accuracy of the URL and version information.

Abernathy, D. (2001) "Get Ready for M-Learning – Mobile Learning – Statistical Data Included", *Training and Development* (February), [http://findarticles.com/p/articles/mi\\_m4467/is\\_2\\_55/ai\\_70659640](http://findarticles.com/p/articles/mi_m4467/is_2_55/ai_70659640) (current July 2, 2007).

About.com, "Circuit City's DIVX Format Bites the Dust", <http://hometheater.about.com/library/weekly/aa062199.htm>, (current Nov. 7, 2007).

Agarwal, R. (2000). "Individual Acceptance of Information Technologies," in Zmud, R. (Ed.), *Framing The Domains of IT Management: Projecting The Future Through The Past*, Cincinnati, OH: Pinnaflex Education Resources, pp. 85-104.

Apple Computer Corporation "iTunes U: The Campus that Never Sleeps", <http://www.apple.com/education/itunesu/index.html> (current July 20, 2007)

Campbell, D.T. and J. C. Stanley (1963) *Experimental and Quasi-Experimental Designs for Research* Denver, CO: Houghton Mifflin.

Chase, M. and A. Zinberg "The Battle Between Beta and VHS", *History of American Technology*, [http://web.bryant.edu/~ehu/h364proj/sprg\\_98/chase/front.htm](http://web.bryant.edu/~ehu/h364proj/sprg_98/chase/front.htm) (current Nov. 7, 2007).

Cobcroft, R., et al. (2007) "Literature Review into Mobile Learning in the University Context", <http://www.eprints.qut.edu.au/archive/00004805/01/4805.pdf> (current Aug. 28, 2007).

Dasgupta, S., Granger, M. and McGarry, N. (2002) "User Acceptance of E-Collaboration Technology: An Extension of the Technology Acceptance Model", *Group Decision and Negotiation* (11), p. 92.

Georgiev, T, E. Georgieva, and A. Smrikarov (2004) "M-Learning – a New Stage of E-Learning," in *International Conference on Computer Systems and Technologies*. Rouse, Bulgaria, June 17-18.

Haskin, D. (2007) "Don't Believe the Hype: The 21 Biggest Technology Flops", *Computerworld* (April), <http://www.computerworld.com/action/article.do?command=printArticleBasic&articleId=9012345> (current Aug. 21, 2008).

Hollis, E. (2004) "M-Learning; The Next Wave for Training and Development," *Chief Learning Officer* (March), [http://www.clomedia.com/content/templates/clo\\_article.asp?articleid=429&zoneid=101](http://www.clomedia.com/content/templates/clo_article.asp?articleid=429&zoneid=101) (current Aug. 30, 2007).

- International Data Corporation (2002) "Online Distance Learning in Higher Education, 1998-2002", quoted in Council for Higher Education, "Distance Learning in Higher Education: An Ongoing Study on Distance Learning in Higher Education Prepared for CHEA by the Institute for Higher Education Policy", <http://www.chea.org/Research/distance-learning/distance-learning-2.htm> (current June 30, 2007).
- Levy, J. A. (1988) "Intersections of Gender and Aging," *The Sociological Quarterly* (29)4, pp. 479-486.
- Lockee, B., J. K. Burton, and L. H. Cross (1999) "No Comparison: Distance Education Finds a New Use for 'No Significant Difference'", *Educational Technology, Research and Development* (47)3, pp. 465-471.
- Meisenberger, M. and A. Nischelwitzer (2006) "The Mobile Learning Engine (MLE) – A Mobile, Computer-aided, Multimedia-Based Learning Application", (paper presented at the Multimedia Applications in Education Conference, Graz, Austria, September 4-6), [http://drei.fh-joanneum.at/mle/docs/Matthias\\_Meisenberger\\_MApEC\\_Paper\\_mLearning.pdf](http://drei.fh-joanneum.at/mle/docs/Matthias_Meisenberger_MApEC_Paper_mLearning.pdf) (current July 18, 2007).
- Minton, H. L., and F. W. Schneider. (1980) *Differential Psychology*, Prospect Heights, IL: Waveland Press.
- Moore, G. C., and I Benbasat (1991) "Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation," *Information Systems Research* (2)3, pp. 192-222.
- Quinn, C. (2000) "mLearning: Mobile, Wireless, In-Your-Pocket Learning", *LINE Zine* (Fall), <http://www.linezine.com/2.1/features/cqmmwiyp.htm> (current Aug. 13, 2007).
- Rogers, E. (1976) "New Product Adoption and Diffusion," *Journal of Consumer Research*, (2) March, <http://www.jstor.org/view/00935301/di007460/00p0085b/0?frame=noframe&userID=80a4e2f3@gwu.edu/01c0a8486400504b408&dpi=3&config=jstor> (current November 7, 2007).
- Russell, T. L. (2001) *The No Significant Difference Phenomenon*, Montgomery, AL: IDECC.
- Traxler, J. (2001) "M-Learning – Evaluating the Effectiveness and Cost", [http://www.mlearning.org/archive/docs/MLEARN\\_2003\\_John\\_Traxler\\_presentation\\_May03.ppt#393.1,m-learning – Evaluating the Effectiveness and the Cost](http://www.mlearning.org/archive/docs/MLEARN_2003_John_Traxler_presentation_May03.ppt#393.1,m-learning – Evaluating the Effectiveness and the Cost) (current Sep. 20, 2007).
- U.S. Department of Education, National Center for Education Statistics (2007) "Survey on Distance Education at Higher Education Institutions, 2001 – 2002" , Postsecondary Education Quick Information System, [http://nces.ed.gov/surveys/pegis/inc/displaytables\\_inc.asp](http://nces.ed.gov/surveys/pegis/inc/displaytables_inc.asp) (current Nov. 7, 2007).
- Venkatesh, V. et al. (2003) "User Acceptance of Information Technology: Toward A Unified View" *MIS Quarterly*, (27)3, p.426.
- W3 Consortium, "Compact HTML for Small Information Appliances", <http://www.w3.org/TR/1998/NOTE-compactHTML-19980209/> (current Sep. 20, 2007).
- Wagner, E. (2007) "Mobile Learning: The Next Step in Technology-Mediated Learning," *Chief Learning Officer* (February), [http://www.clomedia.com/content/templates/clo\\_article.asp?articleid=1686&zoneid=77](http://www.clomedia.com/content/templates/clo_article.asp?articleid=1686&zoneid=77) (current Aug. 28, 2007).

**Appendix I – Modified UTAUT Survey**

M-Learning MOD = Digitized Audio Version of the Face-to-Face Lecture

Item Number	Question
1	<b>I felt that using the M-Learning MOD was voluntary</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5

Item Number	Question
2	<b>How many times did you use the M-Learning MOD?</b> Never 1    1-5 times 2    6-10 times 3    11-15 times 4    >16 times 5

Item Number	Question
3	<b>Using the M-Learning MOD enabled me to accomplish tasks more quickly</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5
4	<b>People who influence my behavior thought that I should use the M-Learning MOD</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5
5	<b>Using the M-Learning MOD increased my productivity</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5
6	<b>The M-Learning MOD was not compatible with other systems I use</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5
7	<b>I found the M-Learning MOD useful in my coursework</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5
8	<b>People who are important to me thought that I should use the M-Learning MOD</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5
9	<b>I intend to use the M-Learning MOD if offered in other courses</b> Strongly Disagree 1    Disagree 2    Neutral 3    Agree 4    Strongly Agree 5

Item Number	Question
10	<b>In general, the organization supported the use of the M-Learning MOD</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
11	<b>I had the resources necessary to use the M-Learning MOD</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
12	<b>I found the M-Learning MOD easy to use</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
13	<b>Learning to operate the M-Learning MOD was easy for me</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
14	<b>It was easy for me to become skillful at using the M-Learning MOD</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
15	<b>I had the knowledge necessary to use the M-Learning MOD</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
16	<b>I plan to use the M-Learning MOD if offered in other courses</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
17	<b>My interaction with the M-Learning MOD was clear and understandable</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
18	<b>A specific person (or group) was available for assistance with M-Learning MOD difficulties</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
19	<b>If I continue to use the M-Learning MOD, I will increase my chances of getting a better grade</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5
20	<b>I predict I would use the M-Learning MOD if offered in other courses</b> Strongly Disagree 1      Disagree 2      Neutral 3      Agree 4      Strongly Agree 5