

2-2015

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Recommended Citation

Krotov, Vlad (2015) "Critical Success Factors in M-Learning: A Socio-Technical Perspective," *Communications of the Association for Information Systems*: Vol. 36 , Article 6.

DOI: 10.17705/1CAIS.03606

Available at: <https://aisel.aisnet.org/cais/vol36/iss1/6>

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Critical Success Factors in M-Learning: A Socio-Technical Perspective

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Abstract:

Educational institutions around the world increasingly view mobile technology as an effective platform for educating a new generation of students. Unfortunately, educational institutions often fail to achieve substantial results with their mobile-learning initiatives. Studies on m-learning have produced several recommendations about how to improve of its success. These recommendations cover a set of factors limited to people, technology, and pedagogy. This qualitative case study adopts a broader socio-technical perspective on m-learning and produces an extended list of critical success factors in m-learning. These factors fall into organization, people, pedagogy, and technology domains. I used the Abilene Christian University as the site for this study. Additional critical success factors I uncovered include executive involvement, resource allocation, technology injection, supporting creation of m-learning content and applications, technological pluralism, championship, infrastructure development, pedagogical freedom, collaboration, continuous learning and improvement, and external recognition.

Keywords: Mobile, Education, Learning, M-Learning, Success, Critical Success Factors.

Volume 36, Article 6, pp. 105-126, February 2015

The manuscript was received 02/12/2013 and was with the authors 6 months for 3 revisions.

I. INTRODUCTION

The millennial generation was born and raised alongside the World Wide Web, social media, and mobile devices. As such, this generation is fundamentally different in the way they process information and acquire knowledge (Carr, 2008). The asynchronous, passive mode of learning involving spending hours in the library or lecture hall tuned to the one-way broadcast of information is increasingly being replaced by active, engaged, and situated learning involving the constant inflow of bits and pieces of information in real time via text messages, social media feeds, and quick Google searches. There is a growing concern that these new habits when retrieving and consuming information are decreasing the new generation's attention span, reading comprehension, and analytical abilities (Carr, 2008). Yet fighting this trend by calling for the young generation to return to library and lecture halls is a battle that cannot be won. Instead, educators should consider embracing mobile learning (m-learning) as a more natural and effective educational platform for the generation of "digital natives" (de-Marcos et al., 2010).

While m-learning is often recognized as an effective approach to educate the millennial generation, educational institutions often achieve poor results in using mobile technology to improve learning (Traxler, 2009). This limited success with m-learning can be explained by the numerous obstacles at the organizational, individual, pedagogical, and technological levels that schools face when pursuing m-learning initiatives. To contribute to m-learning's success in educational institutions, in this paper, I uncover critical success factors in m-learning initiatives in a higher education setting. I used Abilene Christian University, an educational institution with a wide-scale m-learning implementation, as the site for this study.

The rest of this paper is structured as follows. In Section 2, I define m-learning and discuss its strengths and weaknesses. In Section 3, I overview the recommendations that prior research makes on how to improve the chance that m-learning will succeed. I argue that the prior literature has adopted a somewhat narrow perspective on m-learning in that it focuses only on three areas: pedagogy, individual perceptions, and technology. Further, I argue that a broader organizational perspective on m-learning is needed in order to fully understand why certain educational institutions succeed or fail in m-learning. Second, in Section 4, I outline the paper's theoretical perspective, which combines the socio-technical perspective on information systems and the critical success factors (CSF) approach. In Section 5, I overview the site I selected for this study. Section 6 discusses data sources and approach to data analysis. In Section 7, I discuss the critical success factors I uncovered in this study in detail. I integrate these findings with the success factors discussed in the literature to form a comprehensive list of the critical success factors in m-learning. In Section 8, I conclude the paper by making remarks for educational institutions that are planning to implement m-learning.

II. M-LEARNING

M-Learning Defined

The term m-learning is generally used to describe a learning environment where students and instructors can access a learning system over a wireless network using mobile devices anywhere, anytime (Kwon & Lee, 2010). However, this view has been criticized for being overly focused on technology and for not adequately accommodating all the elements and new developments in the m-learning field (Laouris & Eteokleous, 2005). First, restricting m-learning's definition to learning using mobile devices deprives this emerging field from much novelty. For example, carrying around books, notes, or prerecorded lesson on tapes and accessing these materials for information allows, with some limitations, for "anywhere, anytime" learning. Thus, this definition makes it hard to claim that m-learning is a new approach to education. Second, putting technology at the center of the definition ignores other important elements of m-learning such as the learner itself, the social and cultural context in which the learner learns, pedagogical approaches unique to m-learning, and so on. In this study, m-learning is the "mode of learning in which learners may move within different physical and virtual locations and thereby participate and interact with other people, information, or systems—anywhere, anytime" (Koole, 2009, p. 26). Thus, this definition does not limit m-learning to educational models that rely on what is traditionally viewed as a "mobile device" (e.g., cellphone, smartphone, handheld computer, etc.) and does not make a distinction between m-learning and e-learning (in scenarios where e-learning involves anywhere, anytime access to information and interaction patterns similar to the ones used in conjunction with mobile devices).

Strengths and Weaknesses of M-Learning

While m-learning has a number of advantages over the traditional modes of learning, it is still a relatively new development in education with numerous issues that have to be addressed for m-learning to realize its full potential as a new educational platform. Table 1 summarizes m-learning's strengths and its issues (Ally, 2009; Attard, Montebello, & Debattista, 2012; Fraunholz & Unnithan, 2006; Jones et al., 2006; Jung, 2004; Kukulska-Hulme & Pettit, 2009; Lavoie, 2006; Liu, Han, & Li, 2010; Maniar & Bennett, 2007; Marquet, 2010; Peters, 2009; Traxler, 2009), which I discuss in more detail below.

Table 1. M-Learning: Strengths and Weaknesses	
Strengths	Weaknesses
<ul style="list-style-type: none"> • Support for situated learning • Anywhere, anytime access to educational materials • Self-regulated learning and efficient use of time • Conducive to informal learning • Personalized, "just-in-time" learning • A more-natural approach to learning for the millennial generation • Improved access to education in remote areas and developing countries 	<ul style="list-style-type: none"> • Small screen size of mobile devices • Limited battery life of mobile devices • Wireless network coverage and bandwidth issues in some areas • High costs associated with acquiring mobile devices and m-learning infrastructure • Limitations on the quality and volume of visual and textual information that can be delivered using mobile devices • Usability issues related to ergonomics and interfaces of mobile devices • Lack of media richness in comparison with face-to-face learning modes • Incompatibility with certain educational approaches • User and organizational resistance due to possible clashes with social norms and organizational culture

M-Learning's Strengths

M-learning offers several advantages over traditional modes of instruction, such as classroom or textbook-based instruction (Jung, 2004). First, mobile technology allows for situated learning modes. Due to the small size and light weight of mobile devices, students can access and apply educational materials in a real-life setting. Second, due to the convenience of using mobile devices, a learning system can be accessed anywhere and anytime, which allows for self-regulated learning and more efficient use of time. Third, mobile technology allows for informal learning (Jones et al., 2006), where personalized and contextualized educational materials are delivered "just in time" to a specific situation (outside of the educational or work setting) that the learner is a part of (Lavoie, 2006). Fourth, m-learning makes education more accessible in underdeveloped and remote areas, where mobile devices are often the only affordable and reliable means of delivering digital content (Ally, 2009; Fraunholz & Unnithan, 2006).

Most importantly, with the emergence of the so-called "digital natives" (young people who grew up using the Internet and smartphones), mobile technology may be a more natural and, as a result, effective platform for learning compared to the traditional mode that involves physical textbooks and face-to-face lectures (Ally, 2009). The generation gap between teachers and students has always been an important factor hindering effectiveness of learning in higher education. The problem is that teachers, who are typically several generations older than their students, were trained, in turn, by teachers who were several generations older. Whether the new generation is better or worse than the prior one with respect to learning is a subject of considerable debate. However, every new generation is different due to the different environment in which they grow. Today's socio-economic environment is fundamentally different from the environment for which the present day educators were trained. Today's environment is characterized by unprecedented turbulence and change, mass-customization, rapid skill obsolescence, and "round-the-clock" availability of products and services. Interactive, "anywhere, anytime", condensed, compartmentalized, and contextualized learning that can be delivered with mobile devices caters to this new socio-economic environment more effectively than the traditional mode of learning where students spend hours in libraries of lecture halls tuned to a one-way broadcast of information. Thus, m-learning may be a better platform for preparing the millennial generation for successful careers of the future (Johnson, 2008)

Weaknesses of M-Learning

Even though m-learning has the potential to improve effectiveness in learning, there is a considerable gap between what m-learning can potentially bring to the table and what academic institutions have been able to achieve with it

(Liu et al., 2010). M-learning is still a relatively new phenomenon in education and numerous issues prevent individuals and organizations from using m-learning to its full potential (Ally, 2009; Ferreira, Klein, Freitas, & Schlemmer, 2013; Maniar & Bennett, 2007; Marquet, 2010). M-learning's weaknesses typically fall into two broad areas: (1) technological limitations of mobile devices and related technologies, and (2) issues related to the use of m-learning by individuals and organizations in the broader institutional context.

First, the mobile and related technologies used in m-learning have several limitations. One of the most frequently discussed technical problems of mobile technology is the relatively small screen size of many mobile devices (Ally, 2009). A small screen, while allowing for users' mobility, is believed to be less usable than the larger screens of laptop and desktop computers. Small screen size is especially problematic for people with visual impairments (Attard et al., 2012). With a small screen, visual and textual learning materials are typically delivered in small chunks, something that can make access to information tedious (e.g., due to frequent scrolling) and make it difficult for a learner to focus on the "big picture" (Maniar & Bennett, 2007). The battery life of some mobile devices and the limited coverage and bandwidth of wireless networks (at least in some areas) contribute to the problems with mobile devices' usability (Traxler, 2009). In addition, implementing mobile technology as a part of a new educational approach can be quite costly because it may require substantial investment in new IT infrastructure elements (Ally, 2009). Some of the technologies used in m-learning are based on new, evolving standards, which contributes to the cost and complexity of implementing the necessary infrastructure.

Second, issues can arise when individuals in educational institutions and organizations use m-learning. First, at least some groups of users are not very familiar with mobile technology and, thus, are limited in their interaction with, and understanding of, m-learning applications (Kenny et al., 2009). This seems to be especially relevant for older generations of students and educators. This problem can be exacerbated by the usability issues of some mobile devices (e.g., related to ergonomics or poor interface design). Eliminating this lack of technical skills and dealing with the usability issues requires managing user resistance and investing heavily in user training. Second, just like any other form of digital content, m-learning materials may lack the richness of face-to-face interaction among students and instructors (Kenny, Park, Van Neste-Kenny, Burton, & Meiers, 2009). This makes transferring certain types of tacit knowledge difficult and, overall, makes m-learning somewhat incompatible with some pedagogical approaches, such as the ones based on apprenticeship. Third, m-learning may be incompatible with social norms and an educational institution's organizational culture (Traxler, 2009). For example, mobile devices can be perceived as sources of distraction during lectures by some instructors (Kukulaska-Hulme & Pettit, 2009). Moreover, academic institutions that place emphasis on lectures and quality face-to-face interaction between students and instructors may view m-learning a threat to their existing educational models (Peters, 2009). Overall, m-learning is often viewed as a disruptive technology with the potential to make many of today's educational models and educators less relevant. This potential threat creates a considerable degree of resistance towards m-learning at the individual and organizational levels.

III. M-LEARNING CRITICAL SUCCESS FACTORS IN PRIOR LITERATURE

In response to the numerous obstacles that educational institutions face in implementing m-learning, prior research has produced several implicit and explicit recommendations for improving m-learning's success. As I discuss further throughout the paper, I largely focus on three areas: the technology behind m-learning, managing individual differences and perceptions of people involved in m-learning, and the pedagogy behind m-learning.

Technology behind M-Learning

Research on the technology behind m-learning has made the following recommendations. First, research has recommended that technologies behind m-learning should be standardized to ensure that it operates smoothly with educational institutions' existing IT infrastructure (Naish, 2005). Second, when developing mobile applications, developers must take into account the environment in which the application will be used (Guralnick, 2008). By this, I mean the physical classroom environment and the educational context in which mobile technology will be used. Third, academic institutions introducing m-learning should focus on system quality, content quality, and service quality (Gyeong-Min & Soo Min, 2005). Finally, mobile technology has to be easy to use in the classroom and compatible with the way students use educational resources (Mostakhdemin-Hosseini, 2009)

Individual Differences and Perceptions towards M-Learning

Research on individual differences and perceptions in relation to m-learning makes several recommendations for improving m-learning's effectiveness. First, research has demonstrated that m-learning adoption is driven by personal innovativeness (Liu, Li, & Carlsson, 2010); second, that acceptance of mobile technology is influenced by perceived usefulness of m-learning (Liu et al., 2010); and, finally, that courage, openness, and willingness to try something new must be present among faculty in order for m-learning to be successful (Peck, Deans, & Stockhausen, 2010).

Pedagogy behind M-Learning

Finally, research focusing on the pedagogy behind m-learning makes several recommendations. First, educators need to develop pedagogically sound m-learning approaches that enhance learning quality (Brown, 2005). Attaining learning goals should precede the technology. Second, m-learning should be integrated with e-learning (Najima & Rachida, 2008) so that m-learning does not become a central educational strategy (Sameh, 2007). Since m-learning may not be appropriate for all learning scenarios, it should instead be used as one of the tools in a school's educational toolbox. Third, in order for m-learning content to be effective, it should be short and simple (Garff, 2012), which is dictated by the technical limitations inherent to mobile technology, such as its relatively small screen size. Moreover, students should treat lessons delivered through mobile devices as regular lectures by focusing on the content of these lessons and taking notes.

Organizational Critical Success Factors—A Missing Area

While the prior literature provides many useful recommendations for institutions implementing m-learning, one can argue that these studies have a rather narrow view on m-learning. By focusing on m-learning success factors related to technology, pedagogy, and people (see Table 2), prior research has overlooked important organizational factors that may contribute to m-learning's success. It has become somewhat of an axiom in the information systems literature that an information system's success or failure can usually be attributed to a variety of factors that fall into the social and technical domains (Alter, 2013; Bostrom & Heinen, 1977a, 1977b; DeLone & McLean, 1992, 2003). The social domain of technology implementation and use includes both individual and organizational factors and their interactions. Thus, in this study, I expand the list of critical success factors in m-learning with a particular focus on organizational factors behind m-learning success in educational institutions.

Table 2. M-Learning Critical Success Factors Found in Prior Literature

Technology	Pedagogy	People
<ul style="list-style-type: none"> Standardization of technology Compatibility of technology with the physical environment and educational context Quality of mobile information system Quality of mobile services Ease of use of mobile technology Compatibility with student use of educational resources 	<ul style="list-style-type: none"> Pedagogically sound educational approaches behind m-learning Integration of m-learning with other educational approaches, such as e-learning Short and simple mobile educational content Quality of content provided via mobile devices Viewing m-learning as a normal educational process and not as novelty or a form of entertainment 	<ul style="list-style-type: none"> Belief in value of mobile technology in education Personal innovativeness Courage, openness, and willingness to try something new

IV. SOCIO-TECHNICAL PERSPECTIVE ON M-LEARNING

In this study, I use the socio-technical perspective on information systems as my theoretical lens (Alter, 2013; Bostrom & Heinen, 1977a, 1977b; Keen, 1981; Lucas, 1973). I selected this perspective mainly because it allows for a more holistic understanding of why educational institutions succeed (or fail) in implementing m-learning. Information systems in an organization can be viewed as a combination of hardware, software, and people who use them (Alter, 2013). Developing, implementing, and operating information systems in organizations is both a technical and intensely political process (Keen, 1981) and information systems initiatives often fail because managers ignore organizational and behavioral problems associated with designing and operating information systems (Lucas, 1973). Thus, a broad, socio-technical perspective is required to understand the success or failure of organizations' IS initiatives.

Under the socio-technical perspective, an organization is viewed as a combination of social and technical systems. The technical system "is concerned with the processes, tasks, and technology needed to transform inputs to outputs" (Bostrom & Heinen, 1977a, p. 17). The social system "is concerned with the attributes of people (e.g., attitudes, skills, values), the relationships among people, reward systems, and authority structures" (Bostrom & Heinen, 1977a, p. 17). An information system is produced and operated as a result of the interaction between these two systems. Accordingly, "any design or redesign of a work system must deal with both systems in an integrated form" (Bostrom & Heinen, 1977a, p. 18). Consistent with this theoretical lens, I focus on people, technology, processes, and organization areas of an m-learning initiative.

I identify the so-called “critical success factors” in each of these areas. John Rockart, one of the pioneers of the critical success factors (CSFs) method, defined these factors as follows (Rockart, 1979, p. 85):

Critical success factors thus are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where "things must go right" for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired. As a result, the critical success factors are areas of activity that should receive constant and careful attention from management

Combining the socio-technical perspective and the CSFs method together, I identify and expand the list of critical success factors in four areas: organization, people, pedagogy, and technology (see Table 3). I particularly emphasize the organizational area because it has been overlooked by prior literature on m-learning.

Organization	People	Pedagogy	Technology
Critical success factors pertaining to an organization as a whole and impacting all aspects of an m-learning initiative	Critical success factors related to human beliefs, perceptions, and actions in relation to m-learning	Critical success factors related to the educational content, pedagogical approaches, and processes used in conjunction with m-learning	Critical success factors related to mobile technology characteristics, selection, adoption, and use

V. STUDY SITE: ABILENE CHRISTIAN UNIVERSITY

About Abilene Christian University (ACU)¹

I used Abilene Christian University (ACU) as the site for this study (Abilene Christian University, 2012). ACU is a private university located in Abilene, a town with more than 150,000 residents located in West Central Texas, USA. ACU's 350-acre campus is 180 miles west of the Dallas/Fort Worth area. The university was founded in 1906 as Childers Classical Institute. ACU is affiliated with Churches of Christ and places specific emphasis on Christian values in its educational programs and other initiatives. The university is accredited by the Southern Association of Colleges and Schools (SACS). The programs offered by the College of Business are accredited by the Association to Advance Collegiate Schools of Business (AACSB). The university includes four major units: College of Arts and Sciences, College of Biblical Studies, College of Business Administration, and College of Education and Human Services. Other educational units include the Honors College, School of Information Technology and Computing, School of Nursing, School of Social Work, Graduate School, and Graduate School of Theology. Across these units, ACU offers 71 baccalaureate majors, 25 master's degree programs, and a doctoral program in theology. Some of these programs are offered online. In Fall 2013, 4,461 students from 43 nations were enrolled in ACU, with 734 students being enrolled in graduate programs.

The M-Learning Initiative at Abilene Christian University²

2007: The Start of the M-Learning Initiative

Although years of experimentation with various electronic devices, digital educational content, and educational software preceded the m-learning initiative at Abilene Christian University, its official start date was April 18, 2007. This was the date when the first meeting for what would later be known as ACU's mobile learning initiative took place. In May 2007, a team of ACU faculty drafted a proposal for using iPhones as an educational platform. Starting July 2007, the newly established mobile learning executive team began to meet weekly in order to set goals and draft a plan for implementing m-learning at ACU. To support and publicize these efforts, the team began to develop a blog focused on covering various issues related to using mobile technologies in higher education. In August 2007, ACU faculty members were invited to submit applications for m-learning research projects. The main goal of this initiative was to solicit ideas from faculty about the future of education and how ACU could use mobile technology to harness these future trends in learning. The invitation generated substantial interest from ACU faculty, with 70 percent of the faculty submitting an application.

¹ Information about Abilene Christian University is compiled primarily from the university's website: <http://www.acu.edu/>; Information about Abilene is compiled from Wikipedia.

² I compiled the chronological account of the m-learning initiative from the three annual m-learning reports published by ACU, interviews with ACU faculty and staff, and numerous secondary sources.

2008: Preparations for the Roll-Out

In 2008, preparations for m-learning's rollout at ACU continued. In January 2008, the first version of ACU's online, mobile-attendance application system was demonstrated to the ACU community. The application was a part of the ACU's Online Mobile Suite—a proposed collection of mobile applications for enhancing learning via mobile technologies. In January 2008, ACU premiered its “connected” video. The video outlined the university's vision for the future of education at ACU. Mobile technology was included as an important component of that vision. In an attempt to boost mobile technology adoption at the university, ACU's President Royce Money announced in February 2009 that ACU would give an iPhone or iPod Touch to every entering first-year student. In June 2008, the university selected the first group of mobile learning fellows, a group of faculty from various fields sponsored to do research on issues related to m-learning at ACU. In August 2008, Dr. Kyle Dickerson and Dr. William Rankin, two faculty members with extensive knowledge and experience in education and technology, were appointed as “faculty-in-residence” at the Adams Center for Teaching and Learning. The duo was put in charge of assisting individual faculty and ACU as a whole with m-learning. In August 2008, ACU distributed iPhone and iPod Touch devices to all incoming first-year students.

2009: University-Wide Implementation of M-Learning

In 2009, the m-learning initiative at ACU “took off” on a university-wide scale. In February 2009, William Rankin was named Director of Educational Innovation. This new post was created to support ACU's push towards using new methods and technologies in learning. In February 2009, ACU hosted its first ConnectEd Mobile Learning Summit, a conference event designed to serve as a knowledge-sharing platform for students, educators, and technology companies interested in m-learning. More than 400 people from eight countries attended the event. In May 2009, ACU's School of Information Technology and Computing offered its first class designed to teach students how to develop mobile applications for the iPhone. In October 2009, ACU partnered with GetYa Learn On, an Austin-based software company, to develop an iPhone application for teaching students statistics. By the end of Fall 2009, 83 percent of faculty at ACU reported regularly using mobile devices in class (Abilene Christian University, 2010). Fourteen percent of the faculty reported using mobile devices in every class meeting.

2010: Further Expansion of M-Learning

The year 2010 was marked by an increase in the adoption of mobile devices by various stakeholders, the expansion of m-learning infrastructure, and new partnerships in relation to m-learning. In January 2010, Dr. Phil Shubert, ACU's Executive Vice President, announced that all full-time students would be equipped with an iPhone or iPod Touch starting Fall 2010. In February 2010, Dr. William Rankin, ACU's Director of Educational Innovation, was appointed to a distinguished educator advisory board established by Apple. Rankin became one of the 15 board members responsible for leading Apple's initiative, which was designed to help educators around the world to innovate and meet the challenges of the 21st century. Over the spring and summer of 2010, a team of ACU journalism, art and design, and information technology students developed and published an iPad app for the school's newspaper *The Optimist*. The entire project lasted 68 days and was lead entirely by ACU students (with several faculty members playing an advisory role).

In May 2010, AT&T donated US\$1.87 million to ACU. The money was allocated to enhance ACU's m-learning effort in two ways. First, some funds were devoted to building the AT&T Learning Studio on the 3d floor for ACU's Brown Library. The studio was designed to have, among other things, several high-tech conference rooms, a video production facility, an audio recording lab, and a video screening room. The studio was expected to serve as a “a curricular laboratory to support experiments with new media tools and strategies in courses across the curriculum” (Abilene Christian University, 2010, p. 19). Trained technicians were allocated to these media-production facilities to assist students, faculty, and staff in producing media content. Another portion of this donation was allocated to expand ACU's research program on m-learning.

In Spring 2010, ACU also announced a partnership with Cambridge University Press and Alcatel Lucent Bell Labs to develop a digital publishing platform geared towards mobile devices. In Fall 2010, ACU decided to integrate mobile technology into its newly launched core curriculum. The main goal of this integration was to enhance the exchange of ideas among students and multidisciplinary faculty who taught the core curriculum inside and outside of the classroom. In Spring 2010, ACU equipped each of its 35 trustees with an iPad and trained them how to access university-related information and collaborate with each other using the device. At the end of Fall 2010, 84 percent of faculty reported using mobile devices on a regular basis.

2011: Opening of the AT&T Learning Studio and Increased Outreach to the External Community

In 2011, ACU opened its learning studio and increased its outreach to the external community. In February 2011, the AT&T Learning Studio opened its doors on the top floor of ACU's Brown Library. In Summer 2011, ACU began training K-12 educators from the area on using mobile devices in project-based learning (PBL) as part of its K-12

Digital Learning Institute. The main aim of this project was to equip K-12 educators with the pedagogical and technology skills necessary for effective teaching in the digital era. Between February 28 and March 1, ACU held another ConnectEd summit. The conference was attended by 540 educators from nine countries. Steve Wozniak, a co-founder of Apple, was a keynote speaker for the event. By the end of 2011, approximately 111 college and schools from 11 different countries consulted with ACU on m-learning strategies.

2012: M-Learning at ACU Gains External Recognition

In 2012 ACU continued improving its m-learning infrastructure and increased recognition of its m-learning initiative by the external community. In January 2012, Mitzi Adams, an instructor in ACU's Department of Teacher Education, released "Count On It", a mobile app designed to enhance math skills among children. In the same month, Apple recognized ACU with the Apple Distinguished Program Award "for its work to understand the impact of mobility in education, to discover and create new ways to make learning more engaging, and to develop new teaching resources that allow teachers and learners to leverage mobility through iPad, iPhone and iPod" (ACU News, 2012). In February 2012, ACU's AT&T Learning Studio celebrated its first year of operation. In the first year, the studio conducted 13 workshops on digital content creation that 287 participants attended (Learning Studio, 2012). During the same year, ACU students, faculty, and staff checked out microphones and cameras 1,562 times from the studio. In April 2012, ACU held Connected Open House, a conference event to give attendees an opportunity to collaborate with ACU's students, faculty, and staff involved in m-learning.

2013: Greater M-Learning Integration into the Curriculum and Switch to iPads

In 2013, ACU continued expanding its m-learning initiative to all departments on campus and integrating mobile technology into the curriculum. It shifted its emphasis from iPhones and iPod Touches to iPads. Starting Fall 2013, each first year student was required to purchase an iPad 2 or newer. The devices could be purchased through its educational purchase program during ACU's first-year students' orientation. ACU decided not to give out iPads for free (as was the case with iPhones and iPod Touches) mainly due to the fact that many of their incoming students already owned an iPad. Thus, the university decided that giving out iPads for free was both costly and wasteful. Still, ACU continued purchasing iPads for faculty with the aim to equip each faculty member with a new iPad every two years. In June 2013, William Rankin, ACU's former Director of Educational Innovation and a key person behind ACU's m-learning initiative, left ACU to join Apple in Cupertino, California, in the role of Director of Education and Pedagogies (Orr, 2013).

2014: The Current Status

In the beginning of 2014, the m-learning initiative was still in place; however, a few possible areas of concern had emerged. In March 2014, ACU was awarded the Apple Distinguished School Award for a second time. The award was a recognition of the school's innovation, leadership, and educational excellence (Douglas, 2014). In January 2014, George Saltsman, ACU's Executive Director of Educational Innovation, left his post after two years of leadership in m-learning and other educational initiatives at ACU. Saltsman continued being involved with ACU in other strategic roles. Around the same time, ACU stopped publishing its m-learning annual reports and there was a noticeable decrease in information sharing about the m-learning initiative internally and externally.

Reasons for Site Selection

ACU represents a rich site for studying the critical success factors in m-learning. First, ACU has been a pioneer in implementing m-learning on a wide scale. Second, there is evidence that ACU was able to improve learning effectiveness in the university using mobile technology. Third, ACU's success in m-learning has been widely recognized by the university's internal and external stakeholders.

While there was no comprehensive, university-wide study investigating the impact of m-learning on students' learning outcomes, several (predominantly perceptions-based) studies on m-learning's effectiveness were conducted in various courses and programs throughout the duration of the m-learning initiative at ACU. These studies demonstrate positive perceptions towards m-learning among students and faculty, the effectiveness of the school's m-learning initiative in improving student and faculty use of mobile technology, an increased student engagement, and an improved mastery of course materials by students. For example, a 2009 survey conducted by Brad Crisp, an IS professor and mobile learning fellow, shows that ACU students used mobile devices for educational purposes on a daily basis (Abilene Christian University, 2009). Similarly, at the end of Fall 2009, 83 percent of faculty at ACU reported regular use of mobile devices in class with 14 percent using mobile technology in every class meeting (Abilene Christian University, 2010). A later and a more-comprehensive study involving 243 students (224 first-year students and 19 other students) and 167 faculty members demonstrated that both students (89%) and faculty (87%) viewed the m-learning initiative as a success (Perkins & Saltsman, 2010). Overall, the studies' results provide some evidence that learning activities can be successfully transitioned to mobile device platforms. A study by Cynthia Powell, a chemistry professor and another mobile learning fellow at ACU, provides

some indicators that students may perform better in a chemistry lab class when course materials and safety instructions are delivered and accessed in the form of podcasts via mobile devices (as opposed to the traditional, lecture-type delivery of this content) (Abilene Christian University, 2010). The group using podcasts showed higher performance in all assignments used in the class (although the difference was not found to be statistically significant). Another survey conducted in a large first-year class shows that students equipped with an iPhone reported a higher degree of course enjoyment and higher anticipated grades in the course (Abilene Christian University, 2010).

When ACU began adopting iPads as a part of its m-learning initiative, several studies demonstrated the effectiveness of using iPads in learning (Abilene Christian University, 2011). For example, a study conducted in a microeconomics class by Ian Shepherd and Brent Reeves in 2011-2012 shows that iPad usage improved how accessible course materials were to students (Shepherd & Reeves, 2012). Students equipped with an iPad accessed course materials before, during, and after class. Students who used laptops tended to access course materials only during class meetings. Moreover, the results of a controlled study in an undergraduate psychology class show that students who used iPads to prepare for an exam achieved higher test scores (Abilene Christian University, 2011).

Moreover, ACU's external stakeholders has recognized it for the success of its m-learning initiative. ACU's m-learning initiative has been recognized and supported by Google, AT&T, Apple, Alcatel-Lucent, Cambridge University Press, Pearson, and many others. For example, Apple recognized ACU with its Apple Distinguished Program Award "for its work to understand the impact of mobility in education, to discover and create new ways to make learning more engaging, and to develop new teaching resources that allow teachers and learners to leverage mobility through iPad, iPhone and iPod" (ACU News, 2012). The recognition is awarded to educational institutions that are established international centers of excellence in education. Moreover, the ACU faculty involved in the m-learning initiative consulted on the use of mobile technology to hundreds of K12 schools, colleges, and universities in the United States and internationally. In addition, ACU's m-learning initiative received substantial coverage by outlets such as CNBC, *The Texas Tribune*, *CIO Magazine*, *Wired*, and so on. Finally, the m-learning initiative and the related educational innovations were recognized in the U.S. News & World Report and *Forbes Magazine*, which allowed ACU to move up in university rankings.

VI. DATA COLLECTION AND ANALYSIS

Data Collection

I relied on several sources for collecting data. First, I relied on unstructured interviews with ACU faculty, staff, and senior administrators. Second, I observed m-learning student activities to gain a better understanding of how m-learning was used in the classroom. Both data-collection techniques involve detailed note-taking and subsequent written reflections on the observed activities and verbal conversations. Third, I used a variety of secondary data sources. These secondary sources include the school's reports, email correspondence, published research, and news reports related to ACU's m-learning initiative.

Data Analysis

I used the following procedure to analyze the primary and secondary data collected for this study. First, I analyzed notes and other documents collected during the data collection phase to discover "themes" or "concepts" related to success factors behind the m-learning initiative at Abilene Christian University. Second, I used the socio-technical theoretical lens to organize these "themes" or "concepts" into broader categories that fall in specific areas of the socio-technical perspective, such as people, technology, pedagogy, and organization. This step in data analysis involved frequent iterations between theory and data in order to form and refine these categories and their descriptions. A similar procedure is used in the grounded theory tradition (Glaser & Strauss, 1967). Under this approach, critical success factors emerged from the collected data, and these factors drove how I grouped and regrouped these factors into categories. The final step of data analysis involved merging the critical success factors I discovered with those found in the literature to create a broader list of critical success factors in m-learning.

Second, relying on sampling various data sources across time, I used data triangulation to improve the findings' validity (Denzin, 1970). First, as I discuss above, I gathered data for the case study from multiple primary and secondary sources. Second, when concluding the study, when I formulated and described the critical success factors, I contacted the original interviewees again (both collectively and individually) to get their feedback on the study's findings. Moreover, I revisited the previously analyzed secondary sources and retrieved and analyzed new secondary sources in relation to ACU's m-learning initiative. I placed special emphasis on discovering factors and facts that may have been overlooked during my initial round of data gathering and analysis. Moreover, I revisited existing critical success factors and their descriptions in line with the "principle of suspicion" (Klein & Myers, 1999).

This helped to eliminate biases in the study participants' narratives and the outcomes of analyzing the secondary documents about ACU's m-learning initiative. The data triangulation procedure described above resulted in a substantial revision of the critical success factors and their descriptions uncovered during the first cycle of analysis.

VII. FINDINGS

First, in this Section, I discuss critical success factors in m-learning uncovered by this study. I first discuss each factor as a generalization first. I follow the generalization with examples related to the m-learning initiative at ACU. Second, I integrate the critical success factors I uncovered in this study with the critical success factors that the prior literature suggests to create a broader list of critical success factors in m-learning.

Organizational Vision

An m-learning initiative should be viewed as an IT-dependent strategic initiative (Piccoli & Ives, 2005) carried out to achieve a clearly defined organizational vision. A clearly defined and continuously communicated organizational vision of m-learning is important for aligning efforts and ensuring the commitment of stakeholders involved in an m-learning initiative: students, faculty, staff, administrators, and technical specialists.

At Abilene Christian University, the m-learning vision was to build an educational institution that caters to the educational needs and learning habits of future generations. As the beginning of ACU's first annual mobile learning report published in 2009 states (Abilene Christian University, 2009, p. 3):

Our task has, indeed, been to foresee the future, to imagine what learning will look like a decade from now – and a decade after that ... to dream for students who are not yet born and to create for those who are already here. When we say we're working to fashion the university of the future, we mean just that – not only for ACU, but for universities everywhere.

This vision was initially captured and communicated via connected, a 15-minute video featuring ACU students, faculty, and staff. It created a vision for the future of education that ACU was hoping to make a reality (Abilene Christian University, 2012). Many of the applications showcased in the video were fictional yet based on the ideas developed by ACU faculty and staff researchers. ACU communicated this vision to both internal and external stakeholders via various channels, such as presentations at various events and annual m-learning reports.

In the early stages of the m-learning rollout, ACU faced some difficulties in reaching every faculty member with this vision and gaining support for it. While many faculty members became actively involved in implementing m-learning in their courses, others were somewhat resistant to using mobile technology in education. Some instructors went as far as banning mobile devices from being used in class because they viewed mobile devices as a distraction to the learning process. This created a certain degree of confusion and frustration among students. However, over time, the formulation and subsequent popularization of the vision among ACU's internal and external stakeholders resulted in a high level of commitment to the initiative across the organizational units. As ACU's first mobile learning annual report states (Abilene Christian University, 2009, p. 3):

[Our m-learning initiative] is a crystallized product of a vision. It represents the dedicated labor and thinking of hundreds of people at Abilene Christian University – faculty, students, technologists and administrators – all struggling and sacrificing to give that vision shape, dimension and substance.

Executive Involvement

Executive involvement and participation in managing IT has been viewed as one of the most important factors behind an information system's success (Jarvenpaa & Ives, 1991). If senior administrators of an educational institution view m-learning as critical to their organization's success, they will allocate resources to the initiative, provide high-level leadership, and instill appropriate incentives and reward mechanisms for m-learning adoption and use.

Senior administrators at ACU viewed m-learning not as an incremental technological improvement, but rather as a vehicle for reinventing the university, improving its competitiveness, and ensuring its long-term success. The high degree of executive involvement with the m-learning initiative resulted in support, leadership, and allocation of substantial resources to the initiative. But when two key people (William Ranking and George Saltsman) in charge of ACU's m-learning initiative left the mobile learning executive team, there was a slight but visible negative impact. First, ACU stopped publishing its annual m-learning reports. Overall, the faculty felt that there was a decrease in international communication and knowledge sharing internally. Moreover, some faculty felt there was less support available for research in m-learning and a decrease in faculty involvement in certain decisions in relation to m-learning.

Resource Allocation

A successful m-learning initiative may require resources beyond mobile hardware, software, and IT personnel. Additional allocations may involve setting aside research funds for faculty working on m-learning, allocating additional teaching assistants to classes implementing m-learning, providing administrative support for various initiatives, assigning experts from many fields m-learning projects, investing in improving and expanding the existing campus infrastructure, and so on. Some of these allocations may require a substantial financial backing.

ACU assigned some of its top experts in technology, education, and other fields to its mobile learning executive team and other projects related to m-learning. The team provided the school with high-level governance and operational assistance about m-learning. Substantial resources were devoted to developing the infrastructure used to support m-learning, including upgrading the university's wireless network and improving and expanding ACU's Brown Library. Similarly, the initiative to give out an iPhone or iPod Touch to all incoming freshmen announced by ACU's former President, Royce Money, in 2008 required approximately one percent of the university's total budget (Chen, 2009). Finally, the university established the mobile learning fellowship program. The program provided financial support for ACU faculty from various fields conducting research on matters related to the m-learning initiative.

One area of resource allocation that ACU overlooked was teaching and technology support for faculty. Introducing m-learning in a particular class requires faculty to invest substantial amounts of time on the top of their normal (and often heavy) teaching responsibilities. Some faculty reported spending up to two full classes just on helping students get "up and running" with the required m-learning software. Some instructors attempted to alleviate this drain on class time by designing certain assignments around getting students familiar with the m-learning infrastructure used in class. Moreover, ACU needed to provide support for instructors about academic integrity. When most exercises and assessment are done via mobile technology, instructors have less control over what students do on their mobile devices. As such, some students may use external resources during an online quiz or simply ask someone else to take the quiz for them. One way to address this problem is to use an application that can block student access to resources that are not allowed during a test. A more labor-intensive solution involves relying on teaching assistants that would monitor students' activities in class during a test. Thus, allocating additional teaching and technology support to alleviate the additional burden placed on faculty when introducing mobile technology in the classroom is quite important (yet may be overlooked) when implementing m-learning.

Technology Injection

The high cost of mobile devices coupled with a potential lack of perceived value, usability concerns, and low level of computer self-efficacy may result in reluctance to adopt mobile devices among students, faculty, and staff. To motivate the "early and late majority" to "cross the chasm" (Moore, 1991), a school may consider giving out devices for free or at a deep discount. In this way, the school will eliminate some of the financial costs that accompany adopting mobile technology and help address individual resistance to mobile technology.

In the early stages of the m-learning initiative at ACU, one of the biggest barriers to its implementation throughout the university was the fact that many students, faculty, and staff did not have an iPhone, the device ACU adopted to be the primary platform for m-learning. According to Dr. Cheryl Mann Bacon, Professor and Chair of the Department of Journalism and Mass Communication (Abilene Christian University, 2010, p. 16):

One of the biggest challenges in mobile learning has been having classes where perhaps all but one student has an iPhone... That really limited what we were able to do, and knowing we are going to have a saturation of the devices on campus will make it possible for lots of other faculty to become involved in mobile learning.

The mobile learning executive team had realized the importance of students, faculty, and staff having access to a single mobile client and decided to streamline adoption of mobile devices across the university. On February 25, 2008, ACU former President Royce Money made an official announcement to a visiting group of presidential scholars that ACU would give an iPhone or iPod touch to every beginning first-year student (Abilene Christian University, 2009). Although the decision came as a result of substantial research and lengthy deliberations, some of the mass media reporters suspected that this was simply a publicity stunt. Nevertheless, by 2009, ACU handed out 957 devices to incoming freshmen, 169 devices to faculty, and another 182 devices to staff (Abilene Christian University, 2010). By the end of 2009, 2,100 ACU students (48% of the population) and 97 percent of faculty had an iPhone. Furthermore, in 2009, the university announced that, starting Fall 2010, all full-time undergraduate students would be given an iPhone or iPod touch. These initiatives resulted in the almost-universal access to mobile devices by the end of Fall 2010, with 84 percent of ACU's faculty reporting regular use of mobile devices in their classes (Abilene Christian University, 2011).

While the university did not disclose the exact figures invested into the iPhone program, William Rankin, Director of Educational Innovation at ACU, estimated that the initiative amounted to approximately one percent of the university's annual budget (Abilene Christian University, 2010). To offset the costs associated with equipping students, faculty, and staff with a mobile device, the university closed down computer labs in dormitories (Abilene Christian University, 2010). The closure was justified by the fact that the vast majority of students living in dorms owned laptops. According to Rankin, the investment was well-aligned with ACU's vision in relation to m-learning: "one of the things we've wanted to do from the beginning is see how a truly mobile university works, especially as we increase access for all students" (Abilene Christian University, 2010, p. 16).

After a few years (and as a result of substantial research, experimentation, and discussions), the university decided to adopt Apple's iPad as its primary device for m-learning. The decision to switch to iPads was made due the university's m-learning team realizing that iPads had become a more popular and viable platform for m-learning in comparison to iPhones. ACU researchers who had conducted a study on effectiveness of iPads in the classroom made the following conclusion (Shepherd & Reeves, 2012, p. 51):

[the iPad] provides a platform that not only supports the paperless classroom, but also changes student's usage pattern. Students become more efficient at capturing study and learning opportunities throughout their busy week.

Starting Fall 2013, each first year student was required to purchase an iPad 2 or newer. The university decided to abandon its practice of giving out devices to students for free, mainly because it realized that many ACU students already owned an iPad. Thus, the university decided it was wasteful to give out free devices to every student. Those students who did not own an iPad could purchase one through the educational purchase program during ACU's first-year students' orientation. Still, ACU continued purchasing iPads for faculty through Apple's educational purchase program. The program for faculty aimed to equip each faculty with a new iPad every two years.

Supporting Creation of M-Learning Content and Applications

M-learning is not possible without learning applications and educational content designed specifically for mobile devices. Even "tech-savvy" students, faculty, and staff may need training in mobile-application development and mobile content creation in order to produce useful m-learning content. Therefore, an educational institution needs to develop infrastructure that can support students, faculty, and staff in creating m-learning materials. Elements of this infrastructure can include collaboration spaces, audio and video production facilities, and specialized mobile-application development courses.

One of the most significant obstacles to m-learning adoption in the early stages of the initiative at ACU was an absence of quality educational materials and mobile applications that could be used to teach specific subjects and to manage course-related activities (e.g., attendance taking or real-time quizzes). Initially, the university tried to fill this gap by "consuming" existing "ready-made" applications and educational materials. In many instances, existing m-learning materials were found to be ill-suited for the ACU context. Two initiatives helped the university to overcome this obstacle: the creation of mobile-application development courses, and investment in a production facility that supported the development of audio and video content that could be used in m-learning.

First, the university started offering courses on mobile-application development for the university community in May 2009. At the time of writing, ACU offered three courses teaching both IT and non-IT majors how to develop mobile apps for various platforms, such as Android and iOS. By training students in mobile-application development, ACU was able to create a mobile app development community at the university. This resulted in the release and adoption of a number of "in-house" mobile apps that were developed by students, staff, and faculty. Some of these apps were subjected to evaluation studies and showed some evidence of improved student engagement and mastery of course material.

Second, the university used a significant portion of its US\$1.87 million gift from AT&T to build the learning studio, an 8,800 square foot facility located on the third floor of ACU's Brown Library. The AT&T Learning Studio accommodated audio and video production studios, the speaking center, and the library media collections that "support students and faculty as they explore the way we live, learn and communicate in a digital world" (Learning Studio, 2012, p. 18). The audio and video recording studios were professional-grade media-production facilities primarily designed to support faculty in recording audio and video educational materials (e.g., podcasts). The center employed two full-time digital media specialists to assist faculty with recording and producing audio and video materials for their classes. Faculty used the facilities to record high-quality and artistic audio and video educational materials. One of the frequently showcased projects involved embedding an ACU history professor as a narrator and, at times, an active participant in the history documentaries that were available as part of the university's media collection. The speaking center included advanced facilities for creating and practicing individual and collaborative

presentations. These facilities were used by students to create and record course-related presentations. These presentations, once produced and delivered, were used as part of the course's educational content. ACU students, faculty, and staff produced numerous educational resources (e.g., movies, podcasts, multimedia presentations, etc.) using these facilities.

Technological Pluralism

While standardizing technology may eliminate inefficiencies and interoperability problems at the technological level (Naish, 2005), it may also cause user resistance from proponents of alternative technologies. Giving people freedom to choose the technology they think fits best for their task (at least in the early stages of an m-learning initiative) can help organizations to explore various technologies and overcome potential resistance to m-learning from proponents of specific technologies. While standardization has to be implemented at some point to decrease maintenance costs and interoperability problems, some degree of technological pluralism may continue after the decision to standardize technology is made.

In the early stages of the m-learning initiatives, ACU experimented with a variety of mobile devices and software applications in order to evaluate their effectiveness in supporting the university's vision for the future of education and the degree to which those technologies aligned with current learning and media consumption patterns of the new generation. The devices the university experimented with included laptops, Amazon Kindle, PDAs, and various cellphones. Eventually, they chose iPhones as the mobile device of choice (Abilene Christian University, 2009, p. 14):

In Fall 1999, ACU began evaluation of mobile learning by providing IBM laptops to a freshman learning community led by Dr. Paul Lakey, Sherry Rankin, and Randy Daughtory. Later that academic year, Dr. Terry Pope began evaluation of mobile computing in an upper-division course. Though promising, the technology wasn't quite ready. Over the following years, teams of technologists, faculty, and students—led by George Saltsman and others—continued evaluation of laptops, PDAs and cellphones. Each successive generation of technology presented more promise, and ACU gained an increasingly informed understanding of the potential of mobile learning. When the iPhone was announced in January 2007, discussions of mobile learning reached a crescendo. The time to act was at hand.

The decision to adopt the iPhone as a primary device for m-learning was generally well accepted. Yet, it did have some opponents (e.g., those who favored Android-based smartphones). Still, some degree of pluralism in relation to computing devices continued even after the decision to use iPhone as the primary device. For example, a computer lab in ACU library would give students an opportunity to work with both Apple and Windows-based computers. In the same vein, a student could use a laptop in a class by connecting to the school's Wi-Fi network. According to the school's mobile learning executive team, there was no contradiction in this approach. iPhones, laptops, and desktops can be used together, depending on which device is the most appropriate for a particular task. For example, initial field research for a class project can be done using iPhones or iPads to record field data, but the final production of a multimedia presentation based on this field research can be done using a powerful desktop computer. Thus, different computing devices can complement each other as opposed to competing as the primary hardware platform for m-learning.

In the same vein, the school experimented with a variety of software applications and platforms, which included WordPress, Blackboard, Facebook, Google Docs, and many other applications. The university used software openness, ease of use, universal access, and fit with the way the new generation exchange information as the main evaluation criteria for these applications and platforms. No particular consensus was reached with respect to the software to be used in m-learning. The conclusion emerging from this experimentation was that there was no single best software for every class and for every pedagogical approach. While Blackboard was often used for delivering course materials, faculty members were given freedom to use other Web applications in their classes, such as WordPress and Google's Blogger.

Of course, this technological pluralism, while helping overcome resistance from proponents of specific technologies, was not without some serious side effects. Some faculty members actually wanted the university to provide them with a standard m-learning educational platform that could be used and supported across the university. Instead, many instructors had to use several platforms for m-learning in one single class. This required extensive support from the already stretched IT-support personnel to help faculty install these systems and applications and troubleshoot issues arising from using these systems in the classroom.



Championship

A successful m-learning initiative is largely driven by a few students, faculty, and staff members who are highly enthusiastic and motivated to use m-learning technology in their work, studies, and social interactions, and who have a vision with respect to mobile technology extending far beyond the organizational boundaries and beyond its current status quo. These “champions” will motivate and push the community towards new heights (even with limited resources available) and work around the numerous problems that a school is likely to face when implementing m-learning.

At ACU, there was a clear presence of championship among administrators, staff, faculty, and students. Each of these levels included at least a few individuals who were enthusiastic about mobile technology and had a vision with respect to mobile technology that extended far beyond its current application.

One could argue that championship for the broader and more-effective use of m-learning started at the top of the university. As I discuss earlier in the “organizational vision” section above, from the very early stages of the m-learning initiative, senior administrators at ACU viewed m-learning as a vehicle for redefining the university and ensuring its long-term success, and championed the idea across the organization. In addition to that, these champions allocated substantial resources to the initiative.

Similarly, several ACU students took mobile technology far beyond classroom use. For example, two senior information technology majors at ACU became freelance mobile-application developers after taking a class on mobile-application development offered at ACU by a faculty member also viewed as one of the m-learning champions (Abilene Christian University, 2009). The first clients of the mobile development team included ACU itself and Abilene Library Consortium, with many more clients being lined up for their services. The students’ enthusiasm towards mobile technology and the subsequently developed expertise in mobile-application development were used to fuel further development of m-learning at ACU.

Many faculty members at ACU also took mobile technology and m-learning beyond its application in the classroom. For example, some faculty members started doing research related to mobile technology, m-learning, and the use of new media in education. This research helped ACU improve effectiveness of its own m-learning initiative and provided empirically validated guidance about m-learning not only to ACU community, but also to universities worldwide. Other faculty members became involved in public speaking and media appearance related to mobile technology and engaged in consulting related to mobile products and services. Exposure and expertise gained as a result of this type of faculty engagement with internal and external stakeholders contributed to the legitimization and growth of m-learning at ACU.

It is interesting to note that, at times, m-learning champions often came from backgrounds that are not typically associated with technological “know-how” and enthusiasm. For example, some faculty at ACU who came from IT-related fields (e.g., computer science or information systems) exhibited a healthy level of pragmatism and, at times, skepticism in relation to m-learning and its value in education. On the other hand, faculty coming from non-IT fields (e.g., humanities) exhibited great enthusiasm towards using mobile technology for teaching and had unconditional belief in the potential of mobile technology to add value to educational process in the short run and change the educational landscape in the long run. ACU itself, a private, liberal arts school, was a rather unexpected source of innovation in m-learning. While the study cannot explain the emergence of technological leadership from non-technical backgrounds, it is clear that broader stakeholder involvement in m-learning is likely to result in leadership and championship from various areas of organizations.

Infrastructure Development

A successful m-learning initiative may require substantial investment in improving and expanding an educational institution’s the existing infrastructure. The areas of investment may include both IT and physical campus infrastructure. A school may have to invest in computer networks, classrooms, library, study areas, conference rooms, user training, and even audio and video recording studios.

The most immediate area of infrastructure development at ACU involved expanding the campus Wi-Fi coverage and bandwidth to accommodate the thousands of mobiles used by students, faculty, and staff. As one faculty member stated: “Internet and Wi-Fi stability is a major factor. In my class, if the Wi-Fi is down, my class grinds to a halt. Connectivity is everything.”

Having many students in a single spot using a mobile device for downloading and uploading multimedia content puts additional stress on Wi-Fi bandwidth. In addition to that, the classrooms had to be equipped with proper power outlets to give students an opportunity to recharge these devices when needed.

Another significant infrastructure development project at ACU was improving and extending the Margaret and Herman Brown Library. As I discuss in Section 5, the university used a US\$1.87 million gift from AT&T to redesign the library and introduce new facilities that would support the university's m-learning initiative and the school's overall vision with respect to the educational landscape of the future. These improvements were based on the idea that a library should no longer be viewed as a static repository of information resources. M-learning requires a library to become a platform that students, faculty, and library staff can use to collaborate on retrieving, sharing, and creating knowledge anytime and anywhere—a vital characteristic of the interactive, engaged, and unrestricted learning approach characterizing m-learning.

As I discuss in Section 5, the most significant component of the library extension was the learning studio, an 8,800 square-foot facility that accommodated audio and video production studios, the speaking center and the library media collections that “support students and faculty as they explore the way we live, learn and communicate in a digital world” (Learning Studio, 2012, p. 18). The audio and video recording studios were professional-grade media-production facilities primarily designed to support faculty in recording audio and video educational materials (e.g., podcasts). The speaking center included advanced facilities for creating and practicing individual and collaborative presentations. Audio and video recording support was also available to students in the main computer lab of the library.

One bold move the library made was to allow food and drinks in certain areas of the library. This move was consistent with the vision of the library being a platform for unrestricted collaboration and not a tightly monitored place for retrieving information sources. This and many improvements in the library were a result of extensive research on technology, new media usage, library and information sciences, human-computer interaction, and ergonomics and cross-functional collaboration (Learning Studio, 2012, p. 18):

Over a period of three years, faculty and librarians from many disciplines have worked with students, technology leaders, architects, and construction and design teams to produce a one-of-a-kind studio environment. Almost every element—from the ground plan to the technology purchases, from furniture selection to graphic design—was the product of many hours of intentional planning.

According to the library data, all these improvements and investments allowed the library to achieve one of the highest occupancy rates among the nation's university libraries. Moreover, the library became an important platform for collaboration and training in relation to ACU's m-learning initiative.

Pedagogical Freedom

Faculty members should be empowered to use knowledge in their domain and creativity to develop and implement appropriate pedagogical approaches driven by mobile technology. Mobile technology cannot be used in every class for every activity. Faculty members and students should be empowered to decide how mobile technology should be used in their classes, if at all.

There was a remarkable diversity in the nature and extent of m-learning use in various classes and by various instructors at ACU. On one side of the spectrum, there were faculty members who did not believe in m-learning's value in a particular class and who continued to use traditional modes of teaching and learning, such as instructor-driven lectures. One level up were instructors using mobile technology for delivering course materials (e.g., slides, readings, video, etc.) and using mobile technology for course management (e.g., taking attendance, sending reminders, taking polls, etc.). An even higher engagement level involved using mobile technology as a primary vehicle for creating and delivering learning materials and supporting interactive, engaged, collaborative, and media-driven learning unrestricted by time and space. An example of this type of learning involved using mobile devices to allow students to find, analyze, and share online media content related to a particular class topic in real time. Similarly, students were asked to carry out an independent or group field project involving collecting multimedia data using mobile devices (e.g., shooting videos with an iPhone), editing the collected multimedia material, and uploading the deliverables to a popular Web hosting service (as opposed to a formal written report submission). For example, Dr. Houston Heflin, Assistant Professor of Bible at ACU, asked students to create podcasts that would train teachers in churches (Abilene Christian University, 2011, p. 6):

What I am asking my students to do is train teachers in churches in a new way. As an assignment, my students record an audio podcast disseminated through iTunes U. As students create these podcasts and train teachers in churches, the students themselves are going to become better teachers. That will make it worth it to me.

Collaboration

Introduction of m-learning in an educational institution requires cooperation among various internal and external stakeholders, such as students, faculty, staff, senior administrators, peers from other educational institutions, corporate sponsors, and so on. These stakeholders can contribute to an m-learning initiative their time, expertise, and other resources.

ACU's mobile learning executive team has repeatedly emphasized that ACU's m-learning initiative was a result of the joint effort of the entire academic community that involved students, faculty, staff, other educational institutions and corporate entities. As Dr. Phil Shubert, the President of ACU (Abilene Christian University, 2011, p. 32), stated:

As I look back over the past three years, I want to acknowledge the tireless efforts of people throughout our academic community to bring this vision to life. They've collaborated together to discover and research new teaching methods, to develop new tools and applications, and to redefine teaching and learning for a new century. Their innovative leadership has opened doors for collaboration with peers at prestigious schools and with visionaries at important companies, and this work is helping us realize an increasingly ambitious educational vision. Most importantly, they've worked together to prepare our students more effectively and thoroughly for success in a world where mobility and access are playing an increasingly important role.

The m-learning initiative at ACU required considerable cooperation from students. While using mobile technology for learning is natural for the new generation, not all students were enthusiastic about the new mode of learning or have the required skills and resources to participate in it. Therefore, ACU faculty had to find a way to motivate all students to participate in m-learning. Moreover, ACU faculty worked closely with the IT department staff to monitor usage of mobile applications and content and to improve their educational processes based on usage data. For example, business school faculty would request the IT department to provide them server logs in order to monitor when and how students were using mobile applications. Based on this data, the faculty would adjust the technology and associated processes in their class. Even though m-learning relies primarily on a virtual learning environment, it still requires physical space and educational resources. ACU library played an important role in making these resources available to students and faculty participating in m-learning. The library created several learning and collaboration spaces that were used by students and faculty to create digital content.

Further, ACU also collaborated with a number of external stakeholders. ACU faculty engaged in joint research and educational projects with other educational institutions. This allowed ACU to acquire the expertise and research opportunities that were not available internally. ACU also continuously collaborated with the mass media. The m-learning initiative at ACU was truly a team effort, with the team being comprised of numerous internal and external stakeholders. Some of these external activities required substantial administrative and financial support from ACU's administration.

Continuous Learning and Improvement

Schools should maintain a pragmatic attitude to m-learning and continuously evaluate and improve their education strategies and tactics. Implementation of m-learning should draw on research in education, computer science, library science, and ergonomics. Moreover, an educational institution should do internal research to understand people, processes, technology, and organizational factors surrounding their m-learning initiative and make the required changes based on the findings. Evaluation of the impact of m-learning on attainment of student learning outcomes is especially important.

From the very beginning, the m-learning initiative at ACU was driven by research. This research was used to continuously improve m-learning's effectiveness in various areas of the organization. ACU faculty began the m-learning initiative started with research that examined the future of education. The choice of mobile technology (iPhones and iPods) was also a result of a multi-year empirical investigation of the usability of various devices and software applications. Similarly, the library relied on research in library science and ergonomics to adjust their library infrastructure in a way that would support the m-learning initiative. For example, based on prior research, the library decided to allow food and drinks in certain library areas to improve library attendance. Even spacing between tables in the library was informed by the latest empirical research. Throughout the m-learning initiative, ACU faculty engaged in research on the educational effectiveness of mobile technology: they continuously adjusted their pedagogical practices based on these findings. For example, one of the instructors analyzed the server logs provided by the IT department to see when students were accessing class materials and to determine whether there was a correlation between frequency and time of student access to course materials and their academic performance. Having found a significant relationship between time and frequency of access to course materials and academic performance, the faculty member modified his own pattern of technology use: he started posting announcements and uploading course materials before the times of peak access. At the same time, there was no

formal, university, or program-wide study of the impact of m-learning on whether students attained course and program learning outcomes. Given the focus of many government and accreditation bodies on evidence-based learning, an educational institution may consider integrating m-learning evaluation into a formal assurance of learning program.

The culture of continuous, research-driven improvement of m-learning effectiveness at ACU was further supported by establishing the mobile learning fellows program. Each year, ACU appointed several mobile learning fellows from various colleges and fields of the university. These fellows collaborated with the mobile learning leadership team to identify research topics of relevance to the school's m-learning initiative. The fellows investigated a wide array of topics related to m-learning, ranging from evaluating the effectiveness of field-specific mobile applications to the overall organizational impact of mobile technology. Subsequently, these fellows carried out their research investigation and presented their findings at the school's ConnectEd Summit, a conference hosted by ACU and devoted to emerging topics in education. This research has resulted in many valuable insights for the entire organization (Abilene Christian University, 2009, p. 8):

What have we learned so far? Ubiquitous classroom coverage matters, with issues of adequate bandwidth and available channels for large lecture classes representing unforeseen challenges to campus technology infrastructure. Having a device in the hands of every student in the classroom is a prerequisite to broad academic adoption. This is partly why iPhones outperform iPod Touches: iPhones are more likely to be carried in and out of the classroom, and those using them report significantly higher levels of utilization and satisfaction. We've seen that pre-class podcasts and autonomous student review of information can effectively replace laboratory-based lectures with absolutely no decrease in student performance. The majority of students in specific courses where mobile devices have been routinely used rate themselves as having improved their academic performance (grades and organization) and engagement (active learning, contact with professors and teaching assistants, involvement and attention).

External Recognition

While external recognition is largely a result of organizational excellence in relation to m-learning, an educational institution should not overlook the importance of collaborating with the mass media and reaching out to the external community with news and updates about their m-learning initiative. External recognition legitimizes m-learning, provides additional motivation to m-learning team members, and justifies additional funding and support for the initiative.

ACU's m-learning initiative received substantial coverage by the mass media. Within a few years from the start of the initiative, ACU faculty and staff participated in hundreds of interviews, phone consultations, and conference presentations. Mass media coverage of ACU's m-learning initiative involved outlets such as CNBC, *The Texas Tribune*, *CIO Magazine*, *Wired*, and so on. ACU was also invited to join boards and the initiatives of many prominent organizations such as Google, AT&T, Apple, Alcatel-Lucent, Cambridge University Press, Pearson, and many others. The mass media coverage and corporate recognition were accompanied by an improvement in the university's rankings in the U.S. News & World Report and *Forbes Magazine*. This recognition and support from external bodies materialized into additional funding for the m-learning initiative, partnerships in education and mobile content creation, an improved reputation for ACU, and overall legitimization of the university's m-learning program.

Integrated Perspective

To create a broader list of the critical success factors in m-learning, I combined the critical success factors I uncovered in this study with the recommendations found in the prior literature (see Table 4). These factors fall into the organization, people, pedagogy, and technology, which is consistent with the socio-technical theoretical perspective adopted by this study. I discuss each of these areas in an integrated fashion below.

Table 4: Critical Success Factors in M-Learning: An Integrated Perspective

Organization	People	Pedagogy	Technology
<ul style="list-style-type: none"> • Formulation and communication of organizational vision in relation to m-learning • Executive involvement • Resource allocation • Infrastructure improvement and expansion • Collaboration with internal and external stakeholders • Continuous learning and improvement • External recognition 	<ul style="list-style-type: none"> • Personal innovativeness • Courage, openness, and willingness to try something new • Belief in value of mobile technology in education • Championship at various levels 	<ul style="list-style-type: none"> • Pedagogically sound educational approaches behind m-learning • Integration of m-learning with other educational approaches, such as e-learning • Quality of content provided via mobile devices • Viewing m-learning as a normal educational process and not as novelty or a form of entertainment • Pedagogical freedom in relation to using or not using mobile devices in the classroom • Infrastructure for creating short, simple, and effective m-learning content 	<ul style="list-style-type: none"> • Quality of mobile information system • Quality of mobile services • Mobile technology injection • Compatibility of technology with the physical environment and educational context • Ease of use of mobile technology • Compatibility with student use of educational resources • Technological pluralism in the early stages • Standardization of technology in later stages to ensure interoperability and lower costs

An m-learning initiative should start with a clear organizational vision as to where an educational institution wants to be in the future and how mobile technology fits with this vision. Executive involvement and substantial resource allocation should support this vision. An educational institution may need to considerably improve and expand its IT and physical campus infrastructure to support the development and use of m-learning applications and content. Collaboration with internal and external stakeholders and continuous learning and improvement are also essential to help an education institution to achieve its vision in relation to m-learning. Finally, an educational institution should consistently reach out to the external community to gain recognition, legitimization, and support for its m-learning initiative.

An organizational vision with respect to m-learning should be supported by people with personal traits and attitudes conducive to m-learning. These people are usually innovative, open-minded, and courageous in pursuing new approaches in education (Peck et al., 2010). They also have a strong belief in the value of m-learning in education (Liu et al., 2010). Collectively, people with these traits and attitudes can become champions behind m-learning and drive the entire organization to attain its m-learning vision.

Since m-learning is largely an educational platform, educational institutions should develop and implement effective pedagogical approaches that can be used in conjunction with mobile technology (Brown, 2005). First, m-learning should be integrated with e-learning (Najima & Rachida, 2008) so that m-learning does not become a central educational strategy (Sameh, 2007). Since m-learning may not be appropriate for all learning scenarios, it should be viewed as a complement to traditional educational approaches, such as e-learning, and not a replacement. Second, in order for m-learning content to be effective, it should be short and simple (Garff, 2012). This is dictated by the technical limitations inherent to mobile technology, such as its relatively small screen size. Third, m-learning should be viewed by both faculty and students as a normal educational process and not as a novelty or a form of entertainment. Students should be taught to treat lessons delivered through mobile devices as regular lectures. Students should focus on the content of these lessons and take notes. Fourth, a single pedagogical approach may not be appropriate for all learning scenarios. Therefore, faculty should be given freedom to experiment with mobile technology so that they can develop pedagogically sound m-learning approaches for various courses and scenarios. Finally, faculty should be supported in this experimentation with an infrastructure (people and technology) that can assist them in creating mobile content and applications.

Educational institutions should also thrive to ensure quality, appropriateness, and proper deployment of mobile technology behind m-learning. First, an educational institution should focus on assuring the high quality of their mobile technology, mobile services and user support (Gyeong-Min & Soo Min, 2005). Second, to ensure the broader and faster adoption of a mobile technology among students and faculty, educational institutions should consider giving out devices for free or at a considerable discount. The cost of this technology injection can be offset by eliminating some of the wired, desktop-based IT infrastructure in the organization or by arranging a special agreement with technology vendors. Third, when developing mobile applications, developers must take into account the environment in which the application will be used (Guralnick, 2008). The environment includes the physical classroom environment and the educational context in which mobile technology will be used. Mobile technology has to be easy to use in the classroom and compatible with the way students use educational resources (Mostakhdemin-Hosseini, 2009). Fourth, educational institutions should start with a “technological pluralism”, where a variety of mobile devices and platforms are supported, which will help determine which platform suits best and eliminate some of the resistance coming from proponents of specific mobile technologies. Eventually, the technologies behind m-learning should be standardized to ensure that it operates smoothly with educational institutions’ existing IT infrastructure (Naish, 2005).

VIII. CONCLUSION

When contemplating an m-learning environment, educational institutions need to understand that an m-learning initiative cannot be limited to purchasing and deploying mobile technology and training people how to use it. While technology plays an important role in any m-learning initiative, educational intuitions should not overlook the importance of other factors falling into organizational, people, and pedagogy domains. An m-learning initiative should start with a clear organizational vision as to where the institution wants to be in the future and how mobile technology fits with this vision. Executive involvement and substantial resource allocation should support this vision. An educational institution may need to considerably improve and expand its IT and physical campus infrastructure to support development and use of m-learning applications and content. Moreover, universities should foster technological pluralism, pedagogical freedom, and championship in relation to m-learning. Collaboration with internal and external stakeholders and continuous learning and improvement are also essential in helping education institutions to achieve their m-learning vision. Finally, educational institutions should consistently reach out to the external community to gain recognition, legitimization, and support for their m-learning initiatives.

ACKNOWLEDGMENTS

Numerous colleagues and friends of mine contributed to this paper. First of all, I thank the faculty, staff, and administrators at Abilene Christian University (Richard Lytle, Brian Burton, Brad Crisp, Brent Reeves, Ian Shepherd, William Rankin, Lyndell Lee, and many others) for welcoming me at their institution and providing me with valuable information, ideas, and insights related to their m-learning initiative. I also thank my colleagues at Abu Dhabi University (Christopher Dixon, Bob Buchanan, and Pitzel Camba) for their feedback on the initial versions of this manuscript. I also would like express my appreciation to Daniel Evans for meticulously editing and proofreading this paper. I also thank the College of Business (namely, the Dean Jacob Chacko) and the College of Graduate Studies (namely, the Dean Abdel Mohsen Mohamed) at Abu Dhabi University for supporting this research financially. Finally, I thank the editors of the *Communications of the Association of Information Systems* for their timely and constructive feedback on this manuscript. Their selfless help extended beyond the typical responsibilities of journal editors.

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Communications of the Association for Information Systems

ISSN: 1529-3181

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