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Students' Perceptions of a Mobile Application for College Course Management Systems

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This is to certify that the doctoral dissertation by

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Walden University
2011

Abstract

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Roopa Mathur

MS, University of Phoenix, 2004

BS, University of Houston, 1985

Dissertation Submitted in Partial Fulfillment

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Abstract

Higher education administrators need data on student perceptions to support their decision making regarding mobile learning (m-learning) applications. There is a lack of research addressing students' perceptions of mobile applications for course management systems (CMS). The findings of this study may help administrators understand students' perceptions of a CMS m-learning application, Blackboard Mobile Learn (BML). This m-learning application is available on mobile devices, such as the iPad, iPod Touch, iPhone, Android, and Blackberry smartphones. The purpose of this quantitative survey study was to explore the linear relationship between the independent variables of students' perceptions of usefulness and students' perceptions of ease of use with the dependent variable of the students' intent to use BML. The technology acceptance model (TAM) provided the theoretical framework. The study was a survey-based cross-sectional design in which 98 students from 2 community colleges were polled. The results of multiple regression analyses indicated that students' perceptions of usefulness and students' perceptions of ease of use were both significantly and positively related to students' intent to use BML. The results of *t* tests for population means where the variances are unknown confirmed the students' intent to use many of the specific functions of BML: Announcements, Information, Contacts, and My Grades. The findings were inconclusive for Discussions, Assignments, and Course Documents. This study is significant in that it provides college administrators and faculty with supportive data, giving students a new educational platform: mobile learning. The key positive social change provided is a CMS m-learning solution for students to be lifelong learners.

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Dedication

I dedicate this study to my son, Abhay Mathur, and daughter, Swaril Mathur. They have given me immeasurable happiness and love. I am very proud of the adults they have become. I am successful because they are my children.

I also dedicate this study to my mother, Pushpa Mathur, and late father, Bal Krishna Mathur. My dad always believed in me. My mom was always there for me, each and every day, to do anything and everything necessary so that I could accomplish my goal of this PhD. She always said, “I’ll do it, you go and study.”

Lastly, I dedicate this study to my husband, Prabodh Mathur. He taught me to be optimistic and always take the high road. Without his support, I could not have even dreamt of doing this PhD.

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Chapter 1: Introduction to the Study

There is a lack of research regarding higher education students' perceptions of mobile applications for course management systems (CMS), such as Blackboard Mobile Learn. Studies that address this gap may help colleges and university administrators in deciding whether to provide such applications, thereby offering students a new educational platform that is always available: mobile learning (or m-learning). Although most of the peer-reviewed articles in the literature review focused on mobile learning, hardly any involved students' perceptions of mobile applications for course management. Johnson, Levine, Smith, and Stone (2010) forecasted that mobile computing would be one of the most significant emerging technologies in education during the 2010- 2011 school year. Many colleges and universities are implementing mobile learning applications, but the perceived ease of use, perceived usefulness, and usage intentions of these applications are not well researched.

A detailed review of the literature focusing on mobile learning and educational technologies exposed the research methods used, student perceptions, use of technology, and advantages of mobile learning. Many researchers noted the importance and definitions of mobile learning (Al-Fahad, 2009; Caudill, 2007; Chuang, 2009; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Kukulska-Hulme, 2007; Stockwell, 2008; Yousuf, 2007). Chapel (2009) and Andone, Dron, Pemberton, and Boyne (2007) focused on specific mobile learning applications, but did not investigate student perceptions. This study adds to the literature regarding higher education students' perceptions of mobile learning CMS. These concerns are discussed in detail in chapter 2.

The technology acceptance model (TAM) served as the theoretical framework for this study. Proponents of this model, which was developed by Davis (1986, 1989), have theorized that perceived usefulness and perceived ease of use determine an individual's intention to use a system. The survey in this study enabled me to gather information regarding students' perceived usefulness, perceived ease of use, and usage intention regarding the mobile learning application. The web-based survey was conducted at two community colleges (hereinafter called "Abhay College" and "Swaril College"), which are part of the same college district (hereinafter called "Mathur County Community College District"). In this quantitative study, I tested the linear relationship between the independent variables of students' perceptions of usefulness and students' perceptions of ease of use of the mobile learning application with the dependent variable of the students' intent to use the mobile application, Blackboard Mobile Learn. As a result, I developed the research questions to investigate higher education students' perceptions and usage intentions of a CMS mobile application.

Chapter 1 introduces the background of this study, which includes a synopsis of the literature review; the problem statement; and the purpose of the study. This chapter also includes the nature of the study, which describes the research method; the hypotheses; the theoretical framework, which describes the TAM; the operational definitions; the assumptions and limitations; and the significance of the study.

Background of the Study

Many colleges and universities use CMS to deliver course content to their students via an Internet browser to the students' personal computers or laptops. One of the most popular CMS is Blackboard Learn, which provides course announcements, syllabi, documents and handouts, assignments, external links, blogs, discussions, and grades. Blackboard Mobile Learn is a newly released mobile application (or *app*) that offers similar course content on mobile devices, giving students "anytime, anyplace" access to their Blackboard courses (Caudill, 2007, p. 1). The mobile devices currently supported by this mobile application are iPad, iPod Touch, and smartphones iPhone, Android, and BlackBerry (Blackboard Inc., 2010). Like most mobile applications, Blackboard Mobile Learn requires a network connection; hence, the mobile device needs either a Wi-Fi (Wireless Fidelity) connection or a 3G/4G cellular network connection with a data service plan. Blackboard Mobile Learn allows students not only to browse course content but also to interact with courses. For example, a student may read course discussions using his or her iPhone and then add comments to it; this practice is an example of mobile learning.

Simply defined, mobile learning (or m-learning) is edification using mobile devices. As more and more students use smartphones, they expect access to college course information wherever and whenever they want. Johnson et al. (2010) predicted that mobile computing will be one of two emerging technologies in education within the 2010- 2011 school year; the other technology is open content. The challenge is that "people expect to be able to work, learn, and study whenever and wherever they want to"

(Johnson et al., 2010, p. 4). Mobile computing solves this challenge by "maximizing the impact of learning by ensuring it is timely and efficient" (Johnson et al., 2010, p. 4). Johnson et al. discussed several successful examples of mobile computing on college and university campuses, such as, Abilene Christian University, Houston Community College, University of Alabama, Harvard Medical School, and Purdue University. Mobile devices now provide access to information and services that were previously available only on networked personal computers.

Universities and colleges are rapidly implementing mobile applications for this reason, but they need to understand students' perceptions of such mobile applications. There is little research regarding mobile applications, as companies who develop these applications only recently released them to the public. The findings of this study may support decision making at other colleges and universities to deploy mobile learning applications, thus providing students with a new educational tool that will make edification possible whenever and wherever students desire it.

There is a lack of scholarly literature regarding higher education students' perceptions of m-learning CMS such as Blackboard Mobile Learn. In the literature review, most of the scholarly articles centered on mobile learning and only a few involved students' perceptions of a course management mobile application. Many scholars have provided definitions of mobile learning (Al-Fahad, 2009; Caudill, 2007; Chuang, 2009; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Kukulska-Hulme, 2007; Stockwell, 2008; Yousuf, 2007). Caudill, for example, defined mobile learning as dispensing learning content utilizing mobile devices. Many of these

researchers documented the advantages of m-learning (Caudill, 2007; Chuang, 2009; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Kukulska-Hulme, 2007; Yousuf, 2007). Caudill acknowledged that mobile learning truly provides an "anytime, anyplace" learning environment (p. 1). Chuang noted that the benefits of mobile learning are self-paced, on-demand, and real-time instruction.

Researchers who focused on specific mobile learning applications include Chapel (2009) and Andone et al. (2007). Chapel provided a case study of the implementation of the Montclair State University's (MSU) Campus Connect application. This mobile application integrated communication, collaboration, safety, and academics (Chapel, 2009). Academic resources were available through the mobile Blackboard Learning System, which provided course information, such as announcements, syllabi, assignments, handouts, and access to podcasts and videocasts. The reasons provided for implementing MSU Campus Connect included supporting technology initiatives that align with the university's mission, maintaining a lifeline with the students in case of emergencies, increasing academic participation, improving student retention rates, and "strong student participation in a more *well-defined* campus culture" (Chapel, 2009, p. 17). Chapel focused on the four-phase implementation of this mobile application; however, he did not augment the study by surveying students to gain their perceptions of the mobile application.

Andone et al. (2007) developed a scenario-based mobile application design named DIMPLE (Digital Internet and Mobile Phone e-Learning Environment) (p. 48). The researchers conducted focus groups to study the opinions and attitudes of students

regarding this mobile application design. The results, based on students' perceptions, stressed the importance of giving students control over their e-learning environment and implied that DIMPLE may be suited for lifelong learning or hybrid learning. However, Andone et al. did not focus on a widely available CMS mobile application.

Researchers of the scholarly journal articles reviewed for the literature review used a variety of research methods, including surveys with a cross-sectional design, qualitative case studies, and mixed methods. Data analysis in the reviewed articles consisted of descriptive statistics and regression. These subjects are discussed in detail in chapter 2.

Problem Statement

Higher education administrators need data on student perceptions to support their decision making regarding CMS mobile learning applications. The associate director of information technology at the community college district in this study confirmed the educational institution's problem of moving toward mobile technologies (personal communication, September 27, 2010). He articulated that "the problem is we don't know what works and what doesn't work; rather than rush and put everything into a mobile environment, we need to think strategically and put the services that benefit the students" (personal communication, September 27, 2010). This study provided data that may help to understand student perceptions of usefulness and ease of use as predictors of usage for a mobile CMS application.

This study is unique and timely because Blackboard Mobile Learn was recently released and made available to college district students. Universities and colleges need to

understand the students' perceptions of a CMS mobile application to assist their decision making in providing students with the tools they will use to be successful. The findings will be useful to college and university administrators, professors, and students.

My conjecture was that there is a linear relationship between the independent variables of student perception of usefulness and student perception of ease of use and the dependent variable of the intent to use the mobile application, Blackboard Mobile Learn. Currently, there is a lack of research exploring the relationship between the students' perceptions of CMS mobile learning applications and its usage intentions. The findings of this study added to the body of literature and provide supportive data for college and university administrators, professors, and students. This lack of current research is partially due to the fact that these mobile applications were recently released. Nevertheless, because most college students own some type of mobile device, they expect access to their course information whenever and wherever they want. Higher education institutions wish to provide students access to the tools they need to be successful. The importance of and need for mobile learning has prompted the advent of mobile learning solutions, such as Blackboard Mobile Learn. The recent release of the Blackboard Mobile Learn application substantiates this research to investigate the relationship between students' perceptions and usage intentions of this mobile learning application.

Nature of the Study

In this quantitative study, I used a survey with a cross-sectional design to measure students' perceptions and usage intentions of a CMS m-learning application. Quantitative research is used when a hypothesis or theory proposes that a relationship exists between variables (Creswell, 1994). A qualitative study may be used to develop hypotheses, but this study was designed to test several hypotheses, not develop them. In quantitative research, research questions can be used to examine perceptions or attitudes, as done in this study. A qualitative study "is defined as an inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting" (Creswell, 1994, pp. 1-2). In qualitative research, the researcher can ask in-depth questions during interviews regarding why participants hold certain perceptions; however, this type of research was not the focus of this study. Therefore, this study was better suited to quantitative rather than qualitative approaches.

In an experimental research design, the researcher controls for the variables in the experiment (Babbie, 2001). This type of design was not appropriate for this study because it might have required a control group that was denied access to the mobile learning application and a treatment group that was given access to the mobile learning application. Quasi-experimental designs "lack some features (usually randomization) of true experiments, but permit stronger inferences about cause and effect than do pre-experimental designs" (Singleton & Straits, 1999, p. 255). A quasi-experimental design

was also not appropriate for this study. Therefore, a nonexperimental research design was employed.

In a preponderance of the studies reviewed, researchers used the survey research method. In survey research, the researcher distributes a questionnaire to the sample for the purpose of description, explanation, and exploration (Babbie, 2008). Singleton and Straits (1999) noted the extensive use of surveys for descriptive and explanatory purposes. Furthermore, they stated that "among all approaches to social research, in fact, surveys offer the most effective means of social description; they provide extraordinarily detailed and precise information about large heterogeneous populations" (pp. 245-246). The classification of survey questions may include social background information; past behavior; attitudes, beliefs, and values; and behavior intentions (Singleton & Straits, 1999). The survey questions for this study included asking the participants about their social background information, such as their age; their attitudes and perceptions of Blackboard Mobile Learn; and their behavior intentions, such as do they intend to use Blackboard Mobile Learn. For these reasons, survey research was chosen for this study.

A cross-sectional design is one "in which data on a cross section of respondents chosen to represent a larger population of interest are gathered at essentially one point in time" (Singleton & Straits, 1999, p. 556). Cross-sectional design is the most popular type of survey research. On the other hand, a longitudinal design is one in which data are gathered over an extended period of time (Singleton & Straits, 1999). Longitudinal design is better suited for exploring causal relationships or studies in which process and change is involved. Hence, a longitudinal design was not suited for this study. A cross-

sectional design was chosen because this design was better suited for this study, assuming that student perceptions will not change over time.

The data for the independent variables of the students' perceptions of usefulness and students' perceptions of ease of use of the mobile learning application were provided by several questions in the survey. The data for the dependent variable of the intent to use the mobile application were provided by two questions. The scores for each question were calculated using a coded numeric value for each possible response and averaged to obtain a value for each variable; an exploratory factor analysis, which is described in detail in chapter 2, was conducted to help validate each of the predefined multi-item constructs.

The participants were 2-year community college students in southern California who were enrolled in a course that had access to the web-based Blackboard Learn. Some of these students might have had access to Blackboard Mobile Learn on their iPad, iPod Touch, iPhone, Android smartphone, or Blackberry smartphone. However, regardless of whether they used Blackboard Mobile Learn, all participants were able to respond to the questions regarding perceived usefulness, perceived ease of use, and intent to use Blackboard Mobile Learn because of their familiarity with the web-based Blackboard Learn.

The questionnaire was administered electronically to students in the sample a few months after release of the mobile application, Blackboard Mobile Learn. Prior to this implementation, students solely used the web-based CMS, Blackboard Learn, on their personal computers. The survey was available for 2 weeks after the initial e-mail

invitation was sent; a follow-up e-mail reminded the sample to take the survey 3 days prior to the closing of the survey. Use of the mobile application, Blackboard Mobile Learn, is voluntary. Participation in the survey was also voluntary and anonymous.

A self-administered, web-based survey was conducted using closed-end questions, with responses employing the Likert scale. The survey tool SelectSurvey.NET was employed; this tool was available for use from the college district where the survey was conducted. The data were imported from SelectSurvey.NET into SPSS to assist in performing the data analysis.

The survey developed for this study was a descriptive survey to describe the distribution within a population of certain perceptions. I designed the survey instrument using key constructs from previous TAM studies and adhered to basic principles of questionnaire construction (see Appendix A). According to Halawi and McCarthy (2007) TAM has been used to predict technology use; therefore, the survey included questions that predicted the use of Blackboard Mobile Learn.

The quantitative data analysis included both descriptive and inferential analysis using SPSS. Descriptive statistics were used to describe the data. For example, in some studies, a table of the frequency distribution and percentages for the responses to the demographic questions is included. Inferential analysis was conducted to test the hypotheses. As an example, for the first set of hypotheses, I used multiple linear regression analyses to test the linear relationship between the independent variables, perceived usefulness and perceived ease of use, and the dependent variable, intent to use. I tested the second set of hypotheses using *t* tests for population means where the

variances are unknown to explore the students' intent to use specific functions of the mobile application. The research methodology is discussed in greater depth in chapter 3.

Purpose of the Study

The purpose of this quantitative survey study was to explore the linear relationship between the independent variables of students' perceptions of usefulness and students' perceptions of ease of use with the dependent variable of the students' intent to use BML. The cross-sectional design was used to survey 2-year community college students who were enrolled in a course that had access to the web-based Blackboard Learn regarding their perceptions of and intent to use a mobile learning application for course management, Blackboard Mobile Learn, at a community college district in southern California. The independent variables were perceived usefulness and perceived ease of use; the dependent variable was intent to use. In this study, the definitions of these variables drew upon the same key constructs as used by the theorists of the TAM (Venkatesh & Davis, 1996, 2000; Venkatesh, Davis, & Morris, 2007). For example, perceived usefulness was defined in terms of improving performance, increasing productivity, enhancing effectiveness, and also simply being useful; perceived ease of use was defined as clear and understandable, not requiring a lot of mental effort, easy to use, and easy to do what people want the tool to do (Venkatesh & Davis, 1996, 2000; Venkatesh et al., 2007). Universities and colleges need to understand students' perceptions of CMS mobile applications to assist their decision making in providing students with tools to increase their success. This study may help reduce the gap in scholarly research regarding students' perceptions of mobile applications, such as

Blackboard Mobile Learn. The next section states the research questions and hypotheses of this quantitative study.

Research Questions and Hypotheses

Research questions declare the intent of the study (Creswell, 1994; Simon & Francis, 1998). For this study, I developed the research questions to investigate higher education students' perceptions and usage intentions of Blackboard Mobile Learn:

1. Is there a linear relationship between students' usage intentions of Blackboard Mobile Learn and their perceived usefulness and perceived ease of use of Blackboard Mobile Learn?
2. What specific functions of Blackboard Mobile Learn do students intend to use? The functions include Announcements, Information, Contacts, Discussions, My Grades, Assignments, and Course Documents.

In a quantitative research, it is imperative to state and then test the hypotheses for the study. The first set of null hypotheses H_0 and alternate hypotheses H_1 are as follows:

1. $H_0 1$: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and any of the independent variables, students' perceived usefulness and students' perceived ease of use of Blackboard Mobile Learn.

   $H_1 1$: There is a linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and at least one of the two independent variables, students' perceived usefulness and students' perceived ease of use of Blackboard Mobile Learn.

If the null hypothesis ($H_0$1) was rejected, then the following two subsidiary null hypotheses were to be tested:

a. $H_0$1a: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived usefulness of Blackboard Mobile Learn.
   $H_1$1a: There is a linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived usefulness of Blackboard Mobile Learn.
b. $H_0$1b: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived ease of use of Blackboard Mobile Learn.
   $H_1$1b: There is a linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived ease of use of Blackboard Mobile Learn.

The following items were the second set of hypotheses. The 5-point Likert scale being used was defined as follows: +2 represents *strongly agree*, +1 represents *agree*, 0 represents *neutral* (neither agree nor disagree), -1 represents *disagree* and -2 represents *strongly disagree*. The statements were similar to this one: "I intend to use Blackboard Mobile Learn for Announcements."

2. The following null hypotheses state that students do not intend to use Blackboard Mobile Learn for these specific functions: Announcements, Information, Contacts, Discussions, and My Grades ($H_0$2: $\mu \leq +0.5$).

a. $H_0$2a: Students do not intend to use Blackboard Mobile Learn for Announcements ($\mu \leq +0.5$).

   $H_1$2a: Students intend to use Blackboard Mobile Learn for Announcements ($\mu > +0.5$).

b. $H_0$2b: Students do not intend to use Blackboard Mobile Learn for Information, which includes syllabus ($\mu \leq +0.5$)

   $H_1$2b: Students intend to use Blackboard Mobile Learn for Information, which includes syllabus ($\mu > +0.5$).

c. $H_0$2c: Students do not intend to use Blackboard Mobile Learn for Contacts, which includes professor e-mail and office hours ($\mu \leq +0.5$).

   $H_1$2c: Students intend to use Blackboard Mobile Learn for Contacts, which includes professor e-mail and office hours ($\mu > +0.5$).

d. $H_0$2d: Students do not intend to use Blackboard Mobile Learn for Discussions ($\mu \leq +0.5$).

   $H_1$2d: Students intend to use Blackboard Mobile Learn for Discussions ($\mu > +0.5$).

e. $H_0$2e: Students do not intend to use Blackboard Mobile Learn for My Grades ($\mu \leq +0.5$).

   $H_1$2e: Students intend to use Blackboard Mobile Learn for My Grades ($\mu > +0.5$).

3. The following null hypotheses state that students intend to use Blackboard Mobile Learn for these specific functions: Assignments, and Course

Documents ($H_0$3: $\mu \geq -0.5$). There is reason to believe that students will avoid using their mobile devices to complete a quiz or read lecture notes.

a. $H_0$3a: Students intend to use Blackboard Mobile Learn for Assignments, which include homework, quizzes and exams ($\mu \geq -0.5$).

   $H_1$3a: Students do not intend to use Blackboard Mobile Learn for Assignments, which include homework, quizzes and exams ($\mu < -0.5$).

b. $H_0$3b: Students intend to use Blackboard Mobile Learn for Course Documents, which include main course content, lecture notes, or handouts ($\mu \geq -0.5$).

   $H_1$3b: Students do not intend to use Blackboard Mobile Learn for Course Documents, which include main course content, lecture notes, or handouts ($\mu < -0.5$).

Detailed usage statistics data on Blackboard Mobile Learn were not available to the college district from the Blackboard Company. The college district requested that such data be made available in the future; the Blackboard team agreed to add this data to the upgrade list for future versions of the application, but gave no timeframe when usage statistics for Blackboard Mobile Learn will be available. In the meantime, leaders must rely on surveys to assist with decision making at the district. For example, data on how often the Announcement function was used on the Blackboard Mobile Learn application were not available. Therefore, the results of the second set of hypotheses gave insight into the intended usage of these specific functions. I used this quantitative study to test

the research questions and hypotheses. I based the research questions and hypotheses on the theoretical framework, which is discussed next.

Theoretical Framework

Theoretical frameworks in quantitative research help to "provide a conceptual guide for choosing the concepts to be investigated, for suggesting research questions, and for framing the research findings" (Corbin & Strauss, 2008, p. 39). The TAM, developed by Davis (1986, 1989), theorizes that perceived usefulness and perceived ease of use determine an individual's intention to use a system. Perceived usefulness is "defined as the extent to which a person believes that using the system will enhance his or her job performance"; perceived ease of use is "defined as the extent to which a person believes that using the system will be free of effort" (Venkatesh & Davis, 2000, p. 187).

TAM provides researchers with "valid, reliable, and easy to administer scales for the key constructs" (Venkatesh et al., 2007, p. 268). Due to the reliability of these measurement scales, questions for the survey instrument in this study were adapted from this information.

Venkatesh et al. noted the repeatability and validity of TAM. TAM was confirmed to be generalizable over time in various research papers worldwide, testing numerous technologies, diverse settings, and different populations. Predicted validity was also confirmed by a number of research studies investigating intention, self-reported use, and actual use.

A recent research study validated the use of TAM as "a solid theoretical model where its validity can extend to the multimedia and e-learning context" (Saadé, Nebebe,

& Tan, 2007, p. 175). Similarly, for this research, TAM provided the theoretical framework to study the perceived usefulness and perceived ease of use for college students' intent to use a mobile CMS application. A list of the terms and their definitions follows.

Definition of Terms

Operational definitions of key terms are listed below.

Application: A computer application used to perform certain tasks, such as writing a paper, creating a spreadsheet with calculations, or interacting with course content.

Blackboard Learn: A web-based CMS created by Blackboard, Inc. for use on personal computers.

Blackboard Mobile Learn: A CMS created by Blackboard, Inc. for use on mobile devices.

Course management system (CMS): A software application used to deliver course content to students, sometimes for online learning courses; sometimes referred to as Learning Management System (LMS).

Desktop: A personal computer usually used on a desk, which consists of a monitor, a computer tower, and a keyboard/mouse.

E-learning: A teaching method which delivers instruction using any type of electronic media, including Internet, intranets, audio/video tape, and CD-ROM or DVD (Ryu & Parsons, 2009).

Mobile devices: These devices include not only mobile phones, but also devices such as an iPad and an iPod Touch. While some expand this category to include

netbooks, tablets, and laptops, these are not included in the definition of mobile devices for the purpose of this study.

Mobile learning/m-learning: "Learning that happens across locations, or that takes advantage of learning opportunities offered by portable technologies" (Chuang, 2009, p. 51).

Mobile phone: A cellular telephone used to make telephone calls wirelessly using radio waves and a network of overlapping cells in a region (Ryu & Parsons, 2009).

MOODLE: "MOODLE is both an acronym—Modular Object-Oriented Dynamic Learning Environment—and also a colloquial verb that describes the process of creative, nonlinear tinkering that often is characteristic of online learning" (Perkins & Pfaffman, 2006, p. 35).

Perceived ease of use: The degree to which a person believes that using Blackboard Mobile Learn would be free of cognitive effort (Davis, 1989; Saadé et al., 2007).

Perceived usefulness: The degree to which a person believes that using Blackboard Mobile Learn would enhance his or her performance in the course (Davis, 1989; Saadé et al., 2007).

Personal computer (PC): A desktop computer, netbook, tablet, or laptop, as defined for the purpose of this study.

Personal digital assistant (PDA): An electronic handheld device usually used to store information such as address lists and schedules.

Smartphone: A mobile telephone with extended features; for example, a personal calendar function, e-mail capability, Internet browser, and the possibility to run mobile applications. Current popular smartphone models include the iPhone, Blackberry, Android, and the Palm.

Student head count: The number of unduplicated active students measured as of the term census date (Mathur County Community College District, 2009a).

Technology acceptance model (TAM): TAM shows that a person's intent to use a system can be determined by the system's perceived usefulness and perceived ease of use (Davis, 1986, 1989).

A discussion of the assumptions, limitations, scope, and delimitations of this study follows.

Assumptions, Limitations, Scope, and Delimitations

The assumptions of the study included that the students who responded to the survey were truthful and accurate. The results are applicable to the students taking courses using Blackboard Learn at either one of the two colleges only; however, the findings are not applicable to other 2-year or 4-year institutions. Because this study involved a web-based survey, another assumption was that the participants of the survey are part of the intended sample population; for example, it was assumed that only adult college district students taking courses that use Blackboard Learn actually completed the survey. Furthermore, another assumption was that each student completed the survey only one time.

The limitations of the study included that the sample of students who completed the survey were self-selected and the data gathered reflected the perceptions of the students only during the time of the survey. Other limiting factors included the fact that the release of the Blackboard Mobile Learn app occurred only a few months prior to the administration of the survey and this application is available on only five types of mobile devices. Also, because an online survey was used, the target population must have had access to the Internet; physical, psychological, or financial limitations to computer technology might have existed in the population (Sue & Ritter, 2007).

Another limitation was that all the questions in the web-based survey were marked as required. The participants could not move to the next page in the web-based survey unless they answered each of the questions on the web page; if they tried to skip a question, a warning message popped up requesting them to respond to the unanswered questions. In addition, many of the demographics questions included a possible response of *prefer not to mention*, which could have been used as a way to skip a question. The questions pertaining to student perceptions and intentions were all required with no prefer not to mention option. The consent form stated that the participants could stop the survey at any time. Controlling missing values by using either the prefer not to mention option or allowing the students to stop the survey at any time may not be the preferred method for some participants.

The scope of the study included students from two community colleges within the same district in southern California using an electronic survey of closed-ended questions.

The survey focused on student perceptions of a newly released mobile application for course management, Blackboard Mobile Learn.

The delimitations that are integral to the study included that open-ended questions and interviews of students were not used. Based on the literature, I determined that neither was necessary to test the hypotheses adequately. In addition, faculty perceptions of this mobile application were not investigated as part of this study; the focus was on student perceptions. In the future, a longitudinal study could be conducted to see if student perceptions change over time. A discussion of the significance and positive social change of the study follows.

Significance of the Study

This study provided data to reduce the gap in scholarly research regarding students' perceptions of a mobile CMS application. The results of the first set of hypotheses might have indicated a linear relationship between the dependent and independent variables. These results may help college administrators, such as the college director of Public Information and Marketing, to inform students how useful and easy to use this newly released mobile app is for them, thereby encouraging an increase in usage. The results might have shown a linear relationship between the intent to use and usefulness; using this information, the college administrators could create YouTube videos of students talking about the usefulness of this mobile app that could then be posted on the college Facebook page. However, the results might have indicated that there was no linear relationship between the intent to use the mobile app and perceived usefulness and perceived ease of use. In this case, the data gathered would still be useful.

These results might have indicated that the survey was conducted too soon after the release of the mobile learning app; the students did not have time to become familiar with the functionality and benefits of Blackboard Mobile Learn. A similar future study under the same conditions might show different results. A brief tutorial on the app for the students might increase their positive perceptions; this study could be conducted as an experimental study, using a treatment group of students who are given the tutorial. For future studies, researchers may wish to wait until a certain time after release of the application before conducting the survey to see if the linear relationship exists.

The findings from the second set of hypotheses related to the specific Blackboard Mobile Learn functions were also useful. College professors may be able to improve their online Blackboard courses using these findings. For example, a professor may now post weekly assignments in a format conducive for use with mobile devices. Hence, a significance of this study is that it may improve online course delivery for mobile devices.

College and university administrators may find the information and conclusions useful in decision making regarding mobile applications. Faculty and administrators at higher education institutions seek information that may lead to improved edification. Technology initiatives at colleges and universities aim to meet the demands of the students, while aligning with the mission of the institution. Positive responses from students regarding the usefulness of mobile applications may encourage other colleges and universities to implement and support educational mobile applications. Consequently, a further significance of this research is that institutions may provide

students with a new educational platform: mobile learning. Students, whether they are K-12, college, or graduate, have extremely busy lives. They are consistently juggling demands from various aspects of their lives. Students use their mobile devices virtually 24 hours a day, 7 days a week for social and vocational purposes; hence, it makes sense that they will naturally use these devices for educational gains. Mobile learning will provide students with the freedom to learn anytime, no matter where they are located, using any device they prefer, whether it is a personal computer, an iPad, or an iPhone. They can tap into their courses to take advantage of anywhere, anytime learning opportunities, such as waiting for an appointment. Mobile learning applications are a tool that busy students can use to be successful. Additionally, m-learning may provide opportunities for students to continue to take classes. The key positive social change that this study may provide is a CMS m-learning solution for students to be lifelong learners and follow my motto: "Never Stop Learning."

Summary

In chapter 1, I constituted the research problem that there is a lack of research addressing students' perceptions of a CMS mobile learning application. I presented a brief review of the literature to highlight this research gap. I included the assumptions, limitations, scope, delimitations, and definition of terms of the study. The TAM provided the theoretical framework for this study. The research questions and hypotheses are founded on the TAM. In chapter 2, I provide a detailed review of the literature focusing on scholarly articles about mobile learning and educational technology. In chapter 3, I specify the research design and approach, including the survey instrument, sampling,

setting, data collection and analysis. In chapter 4, I present the research tool, pilot study, data collection, data analysis and findings of the study. In chapter 5, I review the research questions, the hypotheses, and the findings of the research.

Chapter 2: Literature Review

Technical literature consists of "reports of research studies, and theoretical or philosophical papers characteristic of professional and disciplinary writing" (Corbin & Strauss, 2008, p. 19). The strategy used to search the technical literature included finding articles in mobile learning and educational technology from peer-reviewed, scholarly journals. The articles, dating from 2006 to 2010, were obtained using online library databases, such as ERIC and Education Research Complete, and keywords such as *mobile learning*, *m-learning*, *iPhone*, *mobile applications*, *educational technology*, and *learning technology*. In addition to using Walden University's online library, I also used local college and university libraries to obtain research and statistics books.

Authors of the articles reviewed for this chapter used various methods and designs, including survey research, case studies, and mixed methods, to study mobile learning and educational technology. While the preponderance of researchers used survey research, some used qualitative methods, such as case studies, and a few researchers used mixed methods, which is a combination of both quantitative and qualitative methods. An examination of the types of sampling used showed the popularity of convenience sampling. Questionnaire construction widely used the Likert scale for closed-ended questions. In the articles reviewed, data analysis procedures predominantly included descriptive statistics; however, some researchers used regression. The research methods used in the peer-reviewed articles are discussed in the first section of this chapter.

The second section of this literature review focuses on the technology acceptance model (TAM). The justification for using this model as the theoretical framework for this study is included. Research studies using the model provided key constructs, reliability, and validity. The research focus of many articles included investigating students' attitudes and perceptions, the use of technology, and the advantages and disadvantages of mobile learning. The third and final section of chapter 2 includes a synthesis of these articles on mobile learning.

Research Methods Used in Mobile Learning

Numerous recent articles in peer-reviewed, scholarly journals predominately focused on mobile learning from various methodological perspectives. Corbin and Strauss (2008) defined methodology as "a way of thinking about and studying social phenomena"; in contrast, methods refer to the "techniques and procedures for gathering and analyzing data" (p. 1). The research methods used in these articles included survey research, case studies, meta-analysis, and mixed methods. A preponderance of the researchers in the referenced articles used the survey research method. Of all the survey research articles, some used only closed-ended questions, while a majority used a combination of both closed-ended and open-ended questions; a few studies used presurveys and postsurveys. The other methods used included case studies, meta-analysis, and mixed methods. A discussion of case studies follows.

Case Studies

Researchers use case studies to explore a specific situation or occurrence to provide detailed data and analysis. Merriam (1988) defined a qualitative case study as

"an intensive, holistic description and analysis of a single instance, phenomenon, or social unit" (p. 21). Babbie (2008) revealed that "the limitation of attention to a particular instance of something is the essential characteristic of the case study" (p. 326). Merriam identified four characteristics essential to qualitative case study: particularistic, descriptive, heuristic, and inductive. The purpose of case studies may be descriptive or explanatory (Babbie, 2008). Case study methodology was identified in three of the scholarly journal articles evaluated for this literature review; these articles described specific implementations of new technologies in an educational setting (Chapel, 2009; Franklin, Sexton, Lu, & Ma, 2007; Haughton & Keil, 2009).

Chapel (2009) provided a case study of the implementation of the Montclair State University's (MSU) Campus Connect application. This mobile application integrated communication, collaboration, safety, and academics (Chapel, 2009). For example, the application included the ability to broadcast campus-wide text alerts in case of an emergency security scenario. Campus clubs and classes used the mobile group collaboration function to plan events and work on projects. This mobile application provided students with mobile access to their campus e-mails, directories, events, calendars, and dining menus. Academic resources were available through the mobile Blackboard Learning System, which provided course announcements, syllabus, schedule, assignments, grades, and access to podcasts and videocasts. This case study provided reasons for implementing this mobile application, which included supporting technology initiatives that align with the university's mission, maintaining a lifeline with the students in case of emergencies, increasing academic participation, improving student retention

rates, and developing "strong student participation in a more *well-defined* campus culture" (Chapel, 2009, p. 17). The case study described the successful rollout that occurred in four phases; the first phase was a voluntary pilot program, whereas the final phase was the requirement for all undergraduate students to have a mobile device with the MSU Campus Connect mobile application.

Another peer-reviewed journal article used the case study method to describe a program that used mobile devices to assess preservice teachers. Haughton and Keil (2009) developed, implemented, and piloted electronic performance assessment of student teachers using mobile devices. In the first phase of this case study, Haughton and Keil recruited eight faculty members from various disciplines to revise the performance assessment instrument; a third party vendor then implemented the revised assessment tool into a web-based application that ran on both laptops and PDAs. In the second phase of this case study, Haughton and Keil recruited field supervisors to field test the revised application on mobile devices. Eighteen supervisors completed a 20-question electronic feedback survey; in addition, a subset of eight supervisors participated in a postproject focus group debriefing session. The researchers analyzed both quantitative data and qualitative data to support the results; this fusion of data and the use of both case study and survey research can denote this study as a mixed-methods research design.

Researchers for another study used the combination of the case study and survey research methods to investigate the use of personal digital assistants (PDAs) in teacher education. The authors of this case study investigated the research question: Can PDAs provide the pedagogical and technological support in higher education classrooms in a

similar fashion as desktop computers (Franklin et al., 2007)? The two research settings included preservice teachers in two courses in the College of Education at a university. One of the strengths of this case study was the varied data collected during an 11-week span from weekly journals, e-mails, pre- and postsurvey of technology skills, classroom observation and application, and personal interviews. For the pre- and post survey of technology skills, the researchers used an existing survey instrument from the U.S. Department of Education. This survey used a 4-point scale to ask questions in the following categories: hardware use (e.g., saving and file organization), productivity (e.g., use of word processing, spreadsheet, and other software), communication (e.g., e-mail, searching the web, and using web sites), and PDA use (Franklin et al., 2007). The self-administered survey results showed improvement, with the respondents rating themselves between an intermediate and expert in all technology skill categories.

Another strength of this case study was the use of the Six Leadership Functions of the Pownell-Bailey model of handheld computing literacy, which tested whether the PDAs provided the pedagogical and technological support in the classroom (Franklin et al., 2007). The research questions covered the following six categories from this model and one additional category: "organizing and planning, reference information, gathering and analyzing, learning and self-improvement, communicating, teaming and collaborating, and technology integration and transfer" (p. 47). The authors concluded the case study by listing supporting examples for each of the seven categories. For instance, the participants used the PDAs for organizing and planning by using the following functions: "To Do Lists, Memo Pad for jotting down notes, Datebook and

alarm to notify student of needed assignments or appointments, Address book for school contact information and team information" (p. 56). An important outcome of the case study was that every student in the two courses created standards-based lesson plans using the PDAs. In this article, the mixture of both qualitative and quantitative data and the use of both case study and survey research may lead some to denote this as a mixed-methods research design. In addition to these two mixed-method articles, two other studies highlighted the use of parallel mixed methods, while a third demonstrated a meta-analysis design.

Mixed Methods

Tashakkori and Teddlie (2009) defined parallel mixed design as when both qualitative and quantitative phases occur in parallel and address the same research questions. Parallel mixed methods may ask both confirmatory and exploratory questions. Two of the research articles used parallel mixed methods to study technological advances.

Andone et al. (2007) conducted a parallel mixed design to define an e-learning environment for digitally minded students. The researchers first conducted an exploratory online survey of young adults in several European universities. Then, based on the issues raised in the survey, they conducted focus groups, interviews, observations, and scenario analysis. The survey results demonstrated a high level of technology use, such as computer, Internet, and mobile phone. More than 50% of the students reported that they used their mobile phone for calling and texting all the time or daily. Students confirmed that they have Internet access at home, a friend's place, the university, work,

and Internet cafes; this survey reported that 11-25% of them, depending on their country, have Internet access on their mobile phones (Andone et al., 2007). An interesting note from the survey indicated that students prefer to use synchronous communication, such as instant messaging, with other students but use asynchronous mode, such as e-mailing, with their professors (Andone et al., 2007). This distinction may be due to the professors' preference for e-mailing rather than instant messaging with students. The results suggested that "digitally-minded students need to control their online and e-learning environment" (p. 46). The survey also reported that the students want personalized delivery, instant feedback, and visually and interactively presented information (Andone et al., 2007). In addition to this quantitative survey research, the authors also gathered qualitative data.

Andone et al. (2007) used the results from the survey to develop a scenario-based mobile application design named DIMPLE (Digital Internet and Mobile Phone e-learning Environment) (p. 48). Two focus groups provided qualitative data based on their opinions and attitudes about the survey results and the DIMPLE mobile application. The results from the focus groups stressed the importance of giving students control over their e-learning environment. In addition, the results showed that DIMPLE may be suited for lifelong learning or hybrid learning. Perhaps the respondents of this 2007 survey were not ready for a college mobile application as their primary source of data. This parallel mixed-methods design of both quantitative and qualitative research helped to support the findings of the initial exploratory survey and provide answers to the same research questions.

Boon et al. (2007) also used parallel mixed methods to research students' attitudes and perceptions of the use of technology-based instruction and a guided notes format for world history classes. They used a combination of the both quantitative and qualitative techniques by using the survey method and grounded theory. Both the survey and the grounded theory research designs provided confirmatory data to satisfy the same research objectives, as is crucial to parallel mixed methods.

In addition to parallel mixed methods, meta-analysis is also a mixed method research design. Singleton and Straits (1999) emphasized the option of combining methodological approaches to combat the disadvantages of any one research approach. Meta-analysis is a viable form of multiple methods. Singleton and Straits defined meta-analysis as the use of "systematic procedures for synthesizing and summarizing the results from previous studies" (p. 413). The research question is answered by examining previous studies (Singleton & Straits, 1999). The following study exemplified a meta-analysis design.

Kukulska-Hulme (2007) used meta-analysis to examine mobile usability in the context of education. The researcher analyzed "usability findings from empirical studies of mobile learning published in the literature" (p. 1). For this study, Kukulska-Hulme investigated user experience, educational requirements, and needs of the mobile learner. Kukulska-Hulme concluded that many of the usability issues were in relation to PDAs because much of the research focused on this device. However, mobile phones may not have the same issues due to user familiarity and technological progress. Technological advances in screen size and resolution, memory, battery life, network speed and

reliability, multimedia capabilities, touch technology, and data inputting may help to alleviate many of the issues PDAs faced in the studies analyzed. Hence, further current research is required in this area of the usability of mobile devices for learning.

Mixed-method articles used the parallel mixed-methods approach, as defined by Tashakkori and Teddlie (2009), and the meta-analysis approach, as defined by Singleton and Straits (1999). The major advantage of mixed methods is that the combination of multiple methods outweighs the disadvantages of a single method. In addition to case studies and mixed methods, researchers in the majority of the scholarly articles reviewed used the survey research method.

Survey Research

In survey research, the researcher distributes a questionnaire to the sample for the purpose of descriptive, explanatory, and exploratory research (Babbie, 2008). As noted previously, a greater part of the reviewed articles on mobile learning used survey research. There are four types of surveys: face-to-face interviews, telephone interviews, self-administered questionnaires, and mixed-mode surveys (Singleton & Straits, 1999). Most of the studies included in this literature review used self-administered questionnaires (Al-Fahad, 2009; Alghazo, 2006; Andone et al., 2007; Boon et al., 2007; Diamanduros, Jenkins, & Downs, 2007; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Haughton & Keil, 2009; Hussain & Adeeb, 2009; Stockwell, 2008). For instance, Alghazo used a self-administered survey to study students' attitudes toward web-enhanced instruction in an educational technology course.

A preponderance of research articles used a combination of both closed-ended and open-ended questions (Alghazo, 2006; Andone et al., 2007; Boon et al., 2007; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Hussain & Adeeb, 2009; Stockwell, 2008). Alghazo used a 20-item questionnaire, which included 14 closed-ended, Likert-scale questions and two open-ended questions. Alghazo used free-response questions to ask about the advantages and obstacles of web-enhanced instruction. In the survey used by Evans, there were fifteen 5-point Likert-scale questions, two open-ended questions, and six demographics questions; the combination of closed-ended and open-ended questions helped researchers to study the effectiveness of mobile learning in the form of podcasting in higher education.

A few used only closed-ended questions (Al-Fahad, 2009; Diamanduros et al., 2007). Diamanduros et al. used only closed-ended questions patterned after instruments in the Pew Internet and American Life Project to analyze technology ownership and selective use among undergraduates. This approach allowed the researchers to compare their undergraduate sample and the Pew teen sample. Al-Fahad used eight Likert-scale closed-ended questions to research students' attitudes and perceptions toward the effectiveness of mobile learning. Using only closed-ended questions have the advantage of only using quantitative data analysis and research design, rather than the more complex mixed methods.

Only some studies used presurveys and postsurveys (Fisher & Baird, 2007; Franklin et al., 2007; Stockwell, 2008). Fisher and Baird conducted presurveys and postsurveys to support their hypothesis that mobile learning technologies provide active

exploration, collaboration, assessment, and reflection in higher education. The presurvey was a short questionnaire given to the students at the beginning of the semester to determine their learning preferences and attitudes about learning and technology (Fisher & Baird, 2007). Stockwell gave an informal questionnaire to first-year students at the start of the semester to determine the number who carried laptop computers and how many used other mobile devices. Only one student carried a laptop, all had a mobile phone with Internet capabilities, but none had experience with mobile learning (Stockwell, 2008). A postsurvey at the end of the semester included both open-ended and Likert-scale closed-ended questions to determine learners' preferences for the mobile platform versus the desktop computer (Stockwell, 2008). In addition, Stockwell analyzed usage patterns of mobile learning to confirm his findings. Fozdar and Kumar (2007) used a pilot study to help construct a valid survey instrument. They conducted this pilot test using 25 students to "further refine and develop the questionnaire" (p. 8). Disadvantages of a pilot study include requiring IRB (Institutional Review Board) approval and additional time and cost.

The survey research methods illustrated examples of surveys that used only closed-ended questions, surveys that used a combination of closed-ended and open-ended survey, presurveys and postsurveys, and pilot surveys. The use of surveys in over 75% of the examined articles illustrated the preference of this method in researching educational technology. Therefore, using the survey research method to investigate mobile learning is an acceptable method. The following section describes the theoretical framework for this study, the TAM.

Technology Acceptance Model

The technology acceptance model (TAM), developed by Davis (1986, 1989), theorizes that perceived usefulness and perceived ease of use determine an individual's intent to use a system. Perceived usefulness is "defined as the extent to which a person believes that using the system will enhance his or her job performance"; perceived ease of use is "defined as the extent to which a person believes that using the system will be free of effort" (Venkatesh & Davis, 2000, p. 187).

TAM aimed to increase understanding of determinants of perceived usefulness in business organizations to increase user acceptance and usage of new systems. The theory was also tested using a sample of undergraduate and MBA students from universities (Venkatesh & Davis, 1996). As such, this theory can be applied to students in an educational setting as well, using course performance as a substitute for job performance. In this research, TAM provided the theoretical framework to study the perceived usefulness and perceived ease of use for college students' intent to use a mobile CMS application.

TAM provided researchers with "valid, reliable, and easy to administer scales for the key constructs" (Venkatesh et al., 2007, p. 268). Venkatesh and Davis (2000) listed the measurement scales and reliabilities for the key constructs as follows:

Intention to Use

(Cronbach's α ranged from 0.82 to 0.97 across studies and time periods)

Assuming I have access to the system, I intend to use it.

Given that I have access to the system, I predict that I would use it.

Perceived Usefulness

(Cronbach's α ranged from 0.87 to 0.99 across studies and time periods)

Using the system improves my performance in my job.

Using the system in my job increases my productivity.

Using the system enhances my effectiveness in my job.

I find the system to be useful in my job.

Perceived Ease of Use

(Cronbach's α ranged from 0.86 to 0.98 across studies and time periods)

My interaction with the system is clear and understandable.

Interacting with the system does not require a lot of my mental effort.

I find the system to be easy to use.

I find it easy to get the system to do what I want it to do. (p. 201)

Venkatesh and Davis (1996) used the mean to calculate the values of the independent and dependent variables for each construct listed above. "The scales were arrived at by determining the average score of the items for each construct" (p. 456). Using the mean to calculate the values of the independent and dependent variables for each construct in this study was supported by the theorists of the TAM. Venkatesh and Davis noted the "strong psychometric properties" of these key constructs, which substantiated the development of their questionnaire (p. 456). Due to the reliability of these measurements scales, questions were based on these data.

In a different article, Venkatesh et al. (2007) noted the repeatability and validity of TAM. TAM was confirmed to be generalizable over time in various research papers

worldwide, testing numerous technologies, diverse settings, and different populations. Predicted validity was also confirmed by a number of research studies investigating intention, self-reported use, and actual use.

TAM was adapted from the social psychology theory of reasoned action by Fishbein and Ajzen in 1975 (Venkatesh et al., 2007). In fact, Davis, Bagozzi, and Warshaw (1989) initially used this theory of reasoned action as a benchmark to compare to TAM. Another theory of interest in technology adoption research is the innovation diffusion theory by Moore and Benbasat developed in 1991. However, TAM was preferred for this study over both the theory of reasoned action and the innovation diffusion theory.

TAM has proven to be a well-established indicator for predicting user acceptance. The two journal articles that introduced TAM (Davis, 1989; Davis et al., 1989) were cited over 1,000 times in research papers about information systems (IS) as well as other topics (Venkatesh et al., 2007, p. 268). Venkatesh et al. confirmed the importance of TAM: "TAM and other technology adoption models are important because they have served as a theory base to study several problems in IS and other fields" (p. 269).

A recent research study validated the use of TAM as "a solid theoretical model where its validity can extend to the multimedia and e-learning context" (Saadé et al., 2007, p. 175). The researchers successfully proved student acceptance of a multimedia learning system, adding to the body of literature supporting TAM's extension as the multimedia acceptance model. Operational definitions for perceived ease of use and perceived usefulness can be derived from the study by Saadé et al.

Pan, Gunter, Sivo, and Cornell (2005) replicated TAM in a correlational study to investigate student attitudes toward the use of WebCT. WebCT was a CMS in competition with Blackboard; in late 2005, Blackboard merged with WebCT and chose to retain only the Blackboard brand (Blackboard Inc., 2005). The researchers of this qualitative study conducted path analysis using structural equation modeling to produce the results (Pan et al., 2005). "Findings of path analysis indicated that the Technology Acceptance Model was successfully tested, which suggested that both perceived ease of use and perceived usefulness are determinants of students' attitudes toward WebCT, which, in turn, determined their WebCT use" (p. 362). Therefore, TAM was used in a study that found students perceived WebCT as easy to use and useful to their coursework; similarly, TAM was used in this study to explore the student perceptions of Blackboard Mobile Learn, a similar CMS for mobile devices.

Friedrich and Hron (2010) conducted research using TAM on a learning management system (LMS) for high school students in Germany. The hypothesis was that "the independent variables would be significantly positive predictors of pupils' acceptance of the E-Learning system" (p. 67). The independent variables were divided into two categories: personal variables, such as attitudes toward computer usage, computer-related self-efficacy, gender, and technology-related variables, such as perceived ease of use and perceived usefulness. A survey using the longitudinal design was used to gather the data at two points in time. The survey questions relating to perceived ease of use and perceived usefulness used the 5-point Likert scale and were based on the TAM framework (Davis, 1989; Friedrich & Hron, 2010). Friedrich and

Hron used factor analysis to support the measurement of the predictor variables. Field (2000) described the purpose and advantage of factor analysis:

> by reducing a data set from a group of interrelated variables into a smaller set of *uncorrelated* factors, factor analysis achieves parsimony by explaining the maximum amount of common variance in a correlation matrix using the smallest number of explanatory concepts." (p. 423)

Descriptive statistics and Pearson Correlation analysis were performed on the variables; the correlations verified the close relationship between the constructs of perceived ease of use and perceived usefulness (Friedrich & Hron, 2010; Venkatesh & Davis, 2000). Correlations are useful but cannot inform researchers about "the predictive power of variables. In regression analyses we fit a predictive model to our data and use that model to predict values of the dependent variable (DV) from one or more independent variables (IVs)" (Field, 2000, p. 103). Thus, multiple regression was the preferred data analysis technique for my study. Friedrich and Hron performed three-step hierarchical multiple regression to prove that personal variables played a minor role, while technology related variables played an important role in acceptance of the learning modules and the LMS.

Halawi and McCarthy (2007) led an important cross-sectional designed study that measured faculty perceptions of Blackboard using TAM. The hypotheses for this research included:

> $H1_a$: There is a positive relationship between faculty perception of usefulness and usage of Blackboard.

$H2_a$: There is a positive relationship between faculty perception of ease of use and usage of Blackboard.

$H3_a$: There is a positive relationship between faculty perception of usefulness and ease of use of Blackboard. (Halawi & McCarthy, 2007, p. 162)

An exploratory factor analysis was performed to test the validity of each of the multi-item constructs. In this study, the factor analysis on the ten perceived usage items resulted in using only four of these items, while six items were dropped. Furthermore, reliability was tested "by assessing the internal consistency of the indicator items representing each construct using Cronbach's Alpha" (Halawi & McCarthy, 2007, p. 163). The researchers performed regression analyses and calculated the coefficient of determination (R^2) to observe the relationship between the independent and dependent variables (Halawi & McCarthy, 2007). The data supported Hypotheses 1 and 3, while Hypothesis 2 was not supported. Therefore, for this study on Blackboard Mobile Learn, TAM provided the theoretical framework to study the perceived usefulness and perceived ease of use for college students' intent to use a mobile CMS application. Furthermore, factor analysis and multiple regression were used to analyze the data and test the hypotheses.

Mobile Learning and Educational Technology Research

All the research articles in this literature review focused on mobile learning or educational technology. Some articles investigated students' perceptions toward a new technology. Other articles researched technology ownership and the use of technology. A number of articles explored the effectiveness of mobile learning, the definition of

mobile learning and the characteristics of mobile learning. A description of the articles that examined students' perceptions follows.

Attitudes and Perceptions

Many of the researchers studied students' attitudes and perceptions toward a new technology, such as mobile learning, podcasting, and other technology-based applications (Al-Fahad, 2009; Alghazo, 2006; Andone et al., 2007; Boon et al., 2007; Croop, 2008; Fozdar & Kumar, 2007; Stockwell, 2008; Yousuf, 2007). An attitude is a feeling or emotion toward a statement; quantitative data are gathered when researching attitudes. For example, Yousuf investigated students' attitudes and perceptions toward the effectiveness of mobile learning in distance education. He conducted a survey consisting of Likert-scale questions and then computed the frequencies, percentages, and means for every question. I used this type of data analysis for the second set of hypotheses to explore the students' intent to use specific functions of the mobile app. Yousuf reported the results that confirmed that a majority of the students' attitudes of mobile learning was positive, indicating that mobile devices provide flexible availability, improved communication between the tutor and the students, and rapid feedback of graded assignments.

Rather than studying student perceptions, Chang (2008) investigated faculty perceptions and utilization of Blackboard. The researcher used power analysis to determine the sample size and multiple regression analyses to answer the research questions. Similarly, I used power analysis to compute the minimum required sample size. In addition, I also used multiple regressions to test the first set of hypotheses.

Chang concluded that there is a significant "relationship between faculty members' perception of Blackboard and their perception of Blackboard's design" (Chang, 2008, p. 4). There is also a significant relationship between faculty members' "capacity of Blackboard use with pedagogical perspective of e-learning" (Chang, 2008, p. 5).

Croop (2008) conducted a study to "gain an understanding of student perceptions of and attitudes toward mobile learning in order to make decisions regarding the role that mobile learning should play in teaching and learning at the institution" (p. iv). The researcher used a two-phase explanatory mixed-methods design using a combination of surveys, focus groups, and interviews. The students favored more mobile access through wireless networks but were "not interested at this time in pursuing the expansion of mobile learning accomplished through the use of mobile devices" (p. 135). The timing of this study is crucial in reviewing the results because a proliferation of mobile devices with educational mobile applications has emerged in the past three years. However, it is important to note that the majority of students with cell phones use them for texting, e-mailing, Internet searching, social networking, listening to music, and playing games. Creating a shift in their use of these devices toward a more educational purpose will require mobile apps that are useful and easy to use. I studied students' perceptions toward a CMS mobile application to discover whether they perceive it to be useful and easy to use. In contrast to exploring students' attitudes, some researchers studied the use of technology.

Use of Technology

Some researchers investigated the use of the technology. They studied how many actually owned mobile phones, laptops, or other mobile devices. They also researched the usage of the technology. For example, how did the students actually use the podcasts available on their mobile devices and on their personal computers? What usability issues were discovered and how could they be overcome?

A few researchers inquired about technology ownership, in addition to their other pursuits (Al-Fahad, 2009; Diamanduros et al., 2007). Diamanduros et al. surveyed students as to their ownership and use of technology. The results indicated that 84% owned either a laptop or desktop computer, with about equal division between laptops and desktops, 35% owned either an Mp3 player or an iPod; 98% owned a cell phone; 10% owned a PDA; 2% owned a Blackberry; and 22% had a landline. An interesting fact was that 53% owned three or more devices, 33% owned two devices, and only 14% owned a single device. I also inquired about my students' technology ownership; I included other devices, such as iPhones or other smart phones, iPod Touch, iPad or other similar tablets, and e-book readers. Future studies could relate how much each device was used per day by students; for example, this number may reveal that laptops and desktops were used for a much larger amount of time than all of the other devices combined because students complete their homework assignments using their laptops and desktops. While a college student may view the course announcements using her mobile phone, she will likely use her laptop to do her assignments.

Many scholarly articles delved into details regarding the usage of the technology (Alghazo, 2006; Andone et al., 2007; Dale & Pymm, 2009; Diamanduros et al., 2007; Fisher & Baird, 2007; Franklin et al., 2007; Haughton & Keil, 2009; Hussain & Adeeb, 2009; Kim, Jain, Westhoff, & Rezabek, 2008; Kukulska-Hulme, 2007; Stockwell, 2008). Kukulska-Hulme reviewed usability studies of mobile learning to report that many of the problems identified were with PDAs. The researcher suggested that future studies track usability issues over a long period. Some of the problems may disappear as the users become more experienced with the device; also, updates from the manufacturer may fix some of the hardware and software bugs. It is also interesting to study how some new devices will be used; for example, a future study of iPad usage may reveal some unforeseen results.

Cavus and Ibrahim (2007) conducted an experimental study to assess the success rates of students using Moodle with a collaborative learning tool GREWPtool. Moodle is an open-source CMS, similar to the vendor-based Blackboard, WebCT, and Desire2Learn. "MOODLE is both an acronym—Modular Object-Oriented Dynamic Learning Environment—and also a colloquial verb that describes the process of creative, nonlinear tinkering that often is characteristic of online learning" (Perkins & Pfaffman, 2006, p. 35). Cavus and Ibrahim reported the results of the study, which proved a higher success rate when Moodle was combined with GREWPtool for the teaching of programming languages over the Internet.

The types of technological gadgets students own may be an interesting part of a study focusing on mobile learning. A future study may use a presurvey to investigate

how the students use these devices; after exposing the students to a mobile learning unit, a postsurvey may again ask how these devices were used. The important research question for future studies may be "how effective is mobile learning?"

Advantages of Mobile Learning

Most of the scholarly articles chosen for this literature review focused on mobile learning. Many studies examined the advantages of mobile learning (Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Yousuf, 2007). Many more research papers provided definitions of mobile learning (Al-Fahad, 2009; Caudill, 2007; Chuang, 2009; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Kukulska-Hulme, 2007; Stockwell, 2008; Yousuf, 2007). Chuang defined mobile learning as "learning that happens across locations, or that takes advantage of learning opportunities offered by portable technologies" (p. 51). Mobile learning is also defined as dispensing learning content utilizing mobile devices (Caudill, 2007). Mobile learning is edification using mobile devices.

Some features of mobile learning are self-paced, on-demand, and real-time instruction (Chuang, 2009). Mobile learning truly provides "anytime, anyplace" learning environment; it provides more flexibility and availability than e-learning systems. Kukulska-Hulme (2007) cited various advantages for using mobile technology in education. Mobile learning can improve access, potentially provide new ways of teaching and learning, and align with the mission of the institutions (Kukulska-Hulme, 2007). Using mobile technology in education can provide opportunities for "collaborative learning, students' appreciation of their own learning process,

consolidation of learning, and ways of helping learners to see a subject differently than why would have done without the use of mobile devices" (Kukulska-Hulme, 2007, p. 4). Mobile learning may help to decrease cultural and communication barriers, while increase just-in-time learning (Kukulska-Hulme, 2007). Mobile learning provides many of the advantages of online learning, but is less restricted due to the use of mobile devices.

Williams (2009) conducted research to assess the effectiveness of m-learning compared to face-to-face (FTF) learning. His research employed the media comparison model to answer the research question regarding the effectiveness of the different modes of delivery. The researcher "employed a quasi-experimental, pretest, posttest design comprising two groups of participants: Control (FTF) and Treatment (M-Learning)" (p. 87). The treatment was provided with an MP3 recording of the FTF lecture hosted on Blackboard. The variables' reliability and validity were verified using Cronbach's alpha and factor analysis. Williams conducted statistical power analysis to determine the minimum required sample size of 43; the values used for this calculation "included 10 predictor variables and an á priori α value (statistical significance level) of .05. An effect size (ES) of .50 and Cohen's recommended power of .80 was adopted" (p. 137). Data analysis consisted of using SPSS to perform hierarchical multiple regression for this longitudinal design. As noted previously, I also used statistical power analysis to determine the sample size and multiple regression to test the first set of hypotheses. Williams concluded that the participants in the face-to-face control group outperformed the m-learning treatment group by an average of 8% on two quizzes.

Disadvantages of Mobile Learning

Although many studies depicted the advantages of mobile learning, other studies indicated the disadvantages as well (Croop, 2008; Kukulska-Hulme, 2007; Stockwell, 2008). Recall that Kukulska-Hulme used meta-analysis to examine mobile usability in the context of education. The researcher identified many usability issues, especially with PDAs. Students identified disadvantages of mobile devices that included inadequate memory storage, short battery life, lack of a regular-sized keyboard, and small screen size. Some tablets were difficult to use outdoors due to screen brightness and reflection issues. The learning curve with mobile applications was also noted by some students; interestingly, very few students took the time to learn the usefulness of new mobile applications.

With many mobile devices requiring either a cell phone signal, such as 3G, or a wireless Internet connection, the slow transmission speed contributed to a negative experience (Kukulska-Hulme, 2007). For example, on the college campus, a student with an iPod Touch who wishes to use Blackboard Mobile Learn must login to the campus-wide wireless network using her student username and password; then, whenever the iPod Touch awakens from sleep mode, which is usually after a few minutes of inactivity, the student must reconnect to the wireless network and authenticate again before she can access the Blackboard Mobile Learn application. This delay will certainly be a deterrent to using mobile applications, most of which require an Internet connection.

Stockwell (2008) investigated usage patterns of mobile learning with students learning English at a Japanese university. The researcher cited barriers to the use of

mobile phones for language learning; these were divided into two categories: easier barriers and more difficult barriers. Easier barriers included keypad factors, screen factors, and pedagogical factors. More difficult barriers included psychological factors, environmental factors, and cost factors. Learners in the study described the slow speed of the pages loading and inputting using the keypad. The researcher noted that some learners felt that PCs are more suited to learning activities which require a longer attention span than mobile devices. Stockwell concluded that although the overall use of the mobile phone for the vocabulary learning task was low, the general attitudes were not negative.

Croop (2008) investigated student perceptions related to mobile learning at a small university. The researcher concluded that students favored more mobile access through wireless networks, but were interested in mobile learning. Students highlighted the inadequate wireless coverage at the university where this study was conducted. The student participants "did not view the cell phone as an instrument that can be used for learning; they think of the cell phone as an indispensible part of their personal lives, but not as a course tool" (p. 138). One of the issues noted by the students was the additional cost of the cell phone and whether the service plans were mandated by the university. However, if using the cell phone was optional, the students were more comfortable with the idea of mobile learning. At this university, the information portal was not available on the cell phones; however, the students showed an interest in getting this information on their cell phones (Croop, 2008). This study of Blackboard Mobile Learn at the two

community colleges in southern California explored the perceptions of students who have their course information available on mobile devices.

Summary

The research methods used in the reviewed articles regarding mobile applications and educational technology included case studies, mixed methods, and survey research. Survey research was used in over 75% of the examined articles. This wide use demonstrated the preference of this research method in researching mobile learning and educational technology. As such, using the survey research method to investigate student perceptions of a mobile learning application for course management is an acceptable method.

The TAM theorizes that perceived usefulness and perceived ease of use determine an individual's intention to use a system. The key constructs for this model are perceived ease of use, perceived usefulness, and intent to use. These key constructs guided the development of the survey instrument for this study, thereby providing reliability and validity to the instrument. TAM is a well established and researched model for technology acceptance. Therefore, it was used for this study on students' perceptions of a CMS mobile learning application, Blackboard Mobile Learn.

Some articles from this literature review have already proven positive students' attitudes toward mobile learning, in general. Others have confirmed the ownership of mobile devices among student populations and the usage of such technology. Additional articles investigated the advantages and disadvantages of mobile learning. However, none of the scholarly articles studied students' perceptions of mobile applications for

course management. One of the intentions of this research was to reduce this knowledge gap.

Some researchers used statistical power analysis for regression to compute the minimum required sample size. Numerous researchers used Cronbach's alpha and factor analysis to confirm validity and reliability of their measurement scales, especially for the TAM variables. Multiple regression was used by most researchers who used the TAM to predict the intent to use a system from the two predictors: perceived usefulness and perceived ease of use. Descriptive statistics were used by researchers to explore the findings of the majority. Therefore, this literature review supported my using these data analysis techniques to determine the sample size, validate my measurement scales, and test my hypotheses. Chapter 3 details the research design, sampling method, and data analysis techniques used in this study.

Chapter 3: Research Method

The first section of this chapter includes a description of the quantitative study. Survey research with a cross-sectional design was used to research students' perceptions and use of a mobile learning application for course management, Blackboard Mobile Learn. The next section, focusing on the setting and participants, includes a description of the population, the sample size and sample frame, and the criteria for selection of participants. The final portions of this chapter describe the data collection and analysis process, the survey instrument, and the protection of human participants.

Research Design and Approach

Quantitative research is used when a hypothesis or theory proposes that a relationship exists between variables (Creswell, 1994). The purpose of this quantitative survey study was to explore the linear relationship between the independent variables of students' perceptions of usefulness and students' perceptions of ease of use with the dependent variable of the students' intent to use BML. In quantitative research, research questions can be used to examine perceptions or attitudes. The perceptions of students who use the mobile application constitute quantitative data. These data were appropriate for this quantitative method. Singleton and Straits (1999) noted the extensive use of surveys because they "offer the most effective means of social description" (pp. 245-246). Survey questions may include social background information; past behavior; attitudes, beliefs, and values; and behavior intentions, all of which were used in this study (Singleton & Straits, 1999). For these reasons, survey research was chosen for this study.

A cross-sectional design is one "in which data on a cross section of respondents chosen to represent a larger population of interest are gathered at essentially one point in time" (Singleton & Straits, 1999, p. 556). For this study, a cross-sectional design was chosen. An experimental research design was not appropriate for this study because it might have required a control group that was denied access to the mobile learning application and a treatment group that was given access to the mobile application. The research questions and hypotheses for this study were based on the TAM and listed in chapter 1.

The methodologies used in past mobile learning research included survey research, case studies, meta-analysis, and mixed methods. A preponderance of the researchers used survey research with a cross-sectional design. In survey research, the researcher distributes a questionnaire to the sample for the purpose of descriptive, explanatory, and exploratory research (Babbie, 2008). Tashakkori and Teddlie (2009) defined survey research as a method in which self-reported data are collected via interviews and/or questionnaires to help predict the behaviors or attributes of the general population. Babbie recommended surveys as "excellent vehicles for measuring attitudes and orientations in a large population" (p. 270). In cross-sectional design, data are obtained from diverse demographic groups at one point in time; in a longitudinal design, data are obtained at multiple points in time. Because this study investigated a diverse sample of students regarding their perceptions of Blackboard Mobile Learn, survey research using a cross-sectional design was the most appropriate method.

Singleton and Straits (1999) categorized the four different types of surveys: face-to-face interviews, telephone interviews, self-administered questionnaires, and mixed-mode surveys. A review of the literature illustrated that most of the studies used self-administered questionnaires (Al-Fahad, 2009; Alghazo, 2006; Andone et al., 2007; Boon et al., 2007; Diamanduros et al., 2007; Evans, 2008; Fisher & Baird, 2007; Fozdar & Kumar, 2007; Haughton & Keil, 2009; Hussain & Adeeb, 2009; Stockwell, 2008). Questionnaires can acquire data about abstract variables such as attitudes, beliefs, feelings, and perceptions (Thomas, 2004). In this quantitative research, the survey included questions that asked participants to choose a rating from a Likert-type scale, select one or more items from a list, or other responses that resulted in numerical data. The findings from this quantitative survey research study helped to address the problem of understanding students' perceptions of a course management system (CMS) mobile application.

Setting and Sample

The setting for this research study was a college district in southern California that consists of two colleges. Trochim (2001) described both theoretical population and accessible population. The theoretical population is defined as the one to which the researcher wants to generalize. The accessible population is defined by the persons to whom the researcher has access. For this survey research study, the theoretical population was the students attending either of the two participating community colleges in southern California.

The combined student headcount at both colleges for Fall 2009 was 43,824 (Mathur County Community College District, 2010). The combined student headcount at both colleges for Fall 2008 and Fall 2007 was 40,087 and 37,009, respectively (Mathur County Community College District, 2009a, 2009b). All class sections are labeled using one of the instructional methods: Classroom, TV/Radio, Internet, and Other. The Internet instructional method includes both Distance Education (DE) and hybrid (mixed mode) class sections. Table 1 depicts the student headcount for Internet classes at both colleges for the 5-year period from Fall 2004 to Fall 2008 (Mathur County Community College District, 2009a, 2009b).

Table 1

Internet Student Headcount

College	Fall 2004	Fall 2005	Fall 2006	Fall 2007	Fall 2008
Swaril College	1554	2362	3147	4438	5207
Abhay College	1171	1417	1443	2035	2401
Total	2725	3779	4590	6473	7608

Note. Adapted from "Institutional Effectiveness Annual Report 2008-2009 Abhay College," by Mathur County Community College District, 2009, and "Institutional Effectiveness Annual Report 2008-2009 Swaril College," by Mathur County Community College District, 2009.

These 5-year data were extrapolated to calculate the estimated Fall 2010 Internet student headcount of 10,019. The actual Fall 2010 Internet student headcount was 10,018, which was almost exactly the estimated value (personal communication, January 14, 2011). The actual Spring 2010 Internet student headcount was 9,355 (personal communication, January 14, 2011). Therefore, the accessible population of the college

district Internet students in Spring 2011, the semester in which the survey was administered, was estimated to be 10,000 (N = 10,000).

To determine the minimum sample size required for this study, statistical power analysis was used. Cohen (1988) emphasized that

> the power of a statistical test of a null hypothesis is the probability that it will lead to the rejection of the null hypothesis. The power of a statistical test depends upon three parameters: the significance criterion, the reliability of the sample results, and the 'effect size,' the degree to which the phenomenon exists. (p. 4)

For the multiple regression analyses used in this study, the following four parameters were needed: probability of type I error (alpha α), probability of type II error (beta β), number of predictor variables, and the effect size (ES), which is f^2 for linear regression; the power = 1-β was used instead of beta β (Cohen, 1988). Cohen provided sample size tables whose "primary utility lies in the planning of experiments to provide a basis for the decision as to the number of sampling units (n) to use" (p. 133). I used these tables to help determine the sample size for the following values: alpha α = 0.05, which is a commonly used value for alpha; power = 0.8 or 80%, which converts to a commonly used value for the type II error β of 0.2, which is also a commonly used value; number of predictor variables = 2, which represent the two independent variables; and the effect size of 0.15. Cohen denoted this effect size as the "medium effect size: $f^2 = .15$" (p. 413).

Using the tables resulted in a minimum sample size N of 68. Although this number may seem small, the literature review confirmed authors of the TAM also used similar sample sizes in their research: n = 48, n = 50, n = 51, and n = 51 (Venkatesh &

Davis, 2000), and $n = 40$, $n = 36$, $n = 32$ (Venkatesh & Davis, 1996). In a similar study where faculty perceptions of Blackboard using TAM were investigated, the sample size was 32 faculty members (Halawi & McCarthy, 2007). Recall that Williams (2009) also used statistical power analysis to calculate the minimum required sample size of 43; he used similar values: 10 predictor variables, an a priori α value (statistical significance level) of .05, an effect size (ES) of .50 and Cohen's recommended power of .80. Therefore, the measured minimum sample size N of 68 from the tables was used. This minimum sample size of 68 allowed me to generalize the results across the population of all students who were enrolled in a course using Blackboard Learn at either of the two participating colleges in southern California.

To account for the return response rate, e-mail invitations were sent to a larger population. Assuming the standard response rate of 15%, I needed to administer at least 454 surveys. Regardless of the actual response rate, all of the survey responses were to be used in the data analysis. Hence, I intended to send e-mail invitations to approximately 500 students (rounding up from the minimum sample size of 454) who were enrolled in a Blackboard course at these two community colleges.

Simple random sampling was used to select approximately 500 students from the total accessible population of 10,000 students. Tashakkori and Teddlie (2009) defined random sampling as "when each sampling unit in a clearly defined population has an equal chance of being included in the sample" (p. 343). I selected the simple random sampling method because the other random sampling methods, systematic, stratified, and cluster, did not fit the purpose of this study. Nonrandom sampling methods include

convenience, quota, snowball, and purposive (Babbie, 2001). According to Tashakkori and Teddlie, purposive sampling is when the sample is based on specific purposes dealing with answering the research questions of the study. Purposive sampling was not used because I did not wish to survey only students who have access to the mobile application; responses from students who did not have access to the mobile application also provided valuable data.

Tashakkori and Teddlie (2009) defined a sampling frame as the list of units from which the sample is selected. The sampling frame for this study was the student roster of all students enrolled in a Blackboard Learn course at either college during the semester the survey was conducted. This sampling frame, which consisted of the e-mail addresses of the sample population, was available from a database query provided by the college district. However, the e-mail addresses provided were grouped in a format so that each course section was identified, but not the individual students; for example, fa99999@abhay.edu automatically sends an e-mail to all Abhay College students in the course identified by the course section number 99999, without listing the students' individual e-mail addresses. This format of the sampling frame helped to preserve the anonymity of the participants. There were some students who were enrolled in multiple courses that used Blackboard Learn; these students received multiple e-mail invitations. Therefore, in the e-mail invitation and again in the procedures section of the consent form, it was noted that each student should complete the survey only once (see Appendix B and Appendix C).

I assumed each course section to have an average of 20 students. Therefore, in order to sample approximately 500 students, 25 course section numbers were required. Hence, 25 course section numbers were selected using simple random sampling on this sampling frame. A random number generator function in SPSS was used to select 25 course section numbers from the list of all course sections that used Blackboard Learn as provided by the college district. E-mails were distributed to students enrolled in these 25 course section numbers.

The sample population received an e-mail from me requesting their voluntary participation in completing an anonymous online survey; the link to the web-based survey was provided in the e-mail (see Appendix B). It was clear in this e-mail that participation was voluntary and anonymous; this clarification helped to avoid the situation where some of the students in the sample may have believed that the survey was part of their course requirement. Due to the large quantity of e-mails that were to be sent, I planned to use a special tool, Blackboard Connect, to send the invitation e-mails. However, Blackboard Connect was not available from the college district at the time the survey was launched; hence, I did not use this tool. I sent the e-mail invitations to commence the actual survey launch (see Appendix B). Three days prior to the closing of the survey, I sent a follow-up e-mail to encourage further participation (see Appendix B).

The eligibility criteria for the study participants was that the community college students must be at least 18 years old and must be registered students in a Blackboard Learn course at either college during the Spring 2011 semester. The students in the

sample were full-time or part-time students, of different adult age groups and ethnicity, and with different educational goals.

There was no treatment group. This was an empirical study involving a cross-sectional design that does not involve a stimulus at all. Furthermore, this was not an experimental research design; therefore, there was no control group that was denied access to the mobile learning application, and no treatment group that was given access to the mobile application. The participants either had access to Blackboard Mobile Learn on their mobile devices or not. The cross-sectional survey instrument is discussed next.

Instrumentation and Materials

A self-administered web-based survey with a cross-sectional design using e-mail invitations was conducted. The advantages of a web-based survey include cost effectiveness, fast turnaround time, anonymity, access to a sampling frame, and direct data entry (Sue & Ritter, 2007). The online survey tool SelectSurvey.NET was used to host the questionnaire and retrieve the raw data.

Self-administered questionnaires are those that the respondents complete themselves; mail and web surveys are examples of this type of survey. This is the least expensive of the three types noted so far because it does not require interviewers, travel expenses, and telephone charges; postal or web survey tool expenses are relatively low (Singleton & Straits, 1999). Self-administered questionnaires give the respondents greater flexibility as to when they can complete the survey, how long they can think about each question, and the opportunity to skip questions or answer them out of order (Singleton & Straits, 1999). Another major advantage is that, because it ensures privacy

for the respondents, they may be more willing to answer sensitive questions in this type of survey. However, the response rates are lower as compared to face-to-face interviews or telephone interviews (Singleton & Straits, 1999). Low response rates may indicate a response bias in the data (Babbie, 2008). Self-administered surveys report more incomplete questionnaires compared to interview surveys (Babbie, 2008). For mailed surveys, follow-ups, such as the original survey plus two follow-up mailings, greatly improve the response rate (Babbie, 2008). Hence, a follow-up e-mail was sent to the sample to encourage survey completion.

One specific type of self-administered surveys is the web survey. Online surveys are particularly suited for populations that visit a specific website (Babbie, 2008). For example, a college portal could provide a link to a survey focusing on student use of mobile technologies. Babbie suggests that researchers should offer to share the results with the respondents because young adults and teens appreciate the information as a reward for completing the survey. Another suggestion is to conduct short online surveys; the survey should not take more than 15 minutes to complete (Babbie, 2008).

The survey developed for this study was a descriptive survey in order to describe the distribution within a population of certain perceptions of a mobile learning application. A cross-sectional survey design was used in which "data are collected at one point in time from a sample selected to describe some larger population *at that time*" (Babbie, 1973, p. 62). Therefore, a cross-sectional survey was most appropriate.

The survey contained closed-ended questions, not open-ended questions. Two popular types of closed-ended quantitative questionnaire are attitude scales and

personality inventories; "attitude scales include measures of attitudes, beliefs, self-perceptions, intentions, aspirations, and a variety of related constructs toward some topic of interest" (Tashakkori & Teddlie, 2009, p. 233). Likert-type attitude scales were used for this survey.

Appendix A contains the survey instrument, which I developed based on surveys found in studies conducted by the theorists of the TAM (Venkatesh & Davis, 1996, 2000). The survey instrument included questions pertaining to demographics data and the mobile application Blackboard Mobile Learn. If a student responded that they do not use the Blackboard Mobile Learn application, they were still requested to complete the survey questions regarding their perceptions and intent to use the mobile app. All the students in this population used the web-based Blackboard Learn; therefore, they were familiar with the functionality of the newly released mobile app, Blackboard Mobile Learn. To help the students visualize the similarities between the mobile app and the web-based Blackboard Learn application, images of Blackboard Mobile Learn were included at the beginning of the survey, along with a link to an interactive demonstration of Blackboard Mobile Learn.

Closed-ended questions use the following response formats: Likert scales, semantic differentials, checklists, and rank orders (Tashakkori & Teddlie, 2009). Some of the questions in the attached survey used the Likert scale, which measured the respondents' level of agreement or disagreement, based on a 5-point scale: *strongly agree*, *agree*, *neutral* (neither agree nor disagree), *disagree*, and *strongly disagree* (Tashakkori & Teddlie, 2009). A sample Likert scale question is:

I would find Blackboard Mobile Learn to be easy to use.

- □ a) Strongly agree
- □ b) Agree
- □ c) Neutral
- □ d) Disagree
- □ e) Strongly disagree

The development of the survey used the recommendations of questionnaire construction (Babbie, 2008; Converse & Presser, 1986; Davies & Mosdell, 2006; Dillman, 2000; Fowler, 1988; Sue & Ritter, 2007; Thomas, 1999). The researcher should keep in mind the competence and willingness of the respondents to answer the items. Other guidelines to keep in mind are that the questions should be clear, relevant, short, void of negative terms, and void of bias (Babbie, 2008).

The researcher should choose the appropriate question type: questions and statements, open-ended and closed-ended questions. If the researcher wishes to know the extent to which the responses display a belief in a particular attitude or perception, a brief statement of the attitude and a list of possible choices may suffice (Babbie, 2008). In closed-ended questions, the respondents choose from a list of possible answers (Babbie, 2008). An example of a closed-ended question is: How many years have you been using a computer? The list of possible answers include: less than 1 year, 1 to 3 years, 4 to 6 years, more than 6 years, and prefer not to mention. The last choice, prefer not to mention, was included in some of the survey questions to avoid missing data, which may not be pertinent to the success of the study.

Davies and Mosdell (2006) recommended that all surveys include asking demographic information because these characteristics about the respondents can make a crucial difference in how they answer the questions. Demographic data is used to describe the respondents, compare the sample to the theoretical population, and compare groups within the sample (Sue & Ritter, 2007). A ubiquitous demographic question is: What is your age group?

The concepts that were measured by the survey instrument included student perceptions of ease of use and usefulness of Blackboard Mobile Learn, which functions the participants use on their mobile, and demographic data. TAM provided the theoretical framework for this study; it focused the study on students' perceived usefulness, perceived ease of use, and intent to use a technology. The data for the independent variables of the students' perceptions of usefulness and students' perceptions of ease of use toward Blackboard Mobile Learn were provided by the following survey questions; the wording of the questions were based on prior TAM research by Venkatesh and Davis (1996, 2000). These statements were randomly ordered in the actual web-based survey:

Perceived Ease of Use:

My interaction with Blackboard Mobile Learn would be clear and understandable.

Interacting with Blackboard Mobile Learn would not require a lot of my mental effort.

I would find Blackboard Mobile Learn to be easy to use.

I would find it easy to get Blackboard Mobile Learn to do what I want it to do.

Perceived Usefulness:

Using Blackboard Mobile Learn would improve my performance in my course(s).

Using Blackboard Mobile Learn in my course(s) would increase my productivity.

Using Blackboard Mobile Learn would enhance my effectiveness in my course(s).

I would find Blackboard Mobile Learn to be useful in my courses.

The data for the dependent variable of the intention to use the mobile application were provided by the following statements:

Assuming I had access to Blackboard Mobile Learn, I intend to use it.

Given that I had access to Blackboard Mobile Learn, I predict that I would use it.

Construct validity is "the degree to which the constructs under investigation are captured/measured" (Tashakkori & Teddlie, 2009, p. 298). To ensure construct validity, an exploratory principal components analysis was performed, as was done in similar studies using TAM (Friedrich & Hron, 2010; Halawi & McCarthy, 2007; Venkatesh & Davis, 1996, 2000). Factor analysis is often "used for simplifying complex data by finding the minimum number of dimensions that can be used to describe them without leaving a large amount of the variance unexplained" (Sapsford & Jupp, 1996, p. 278). Thus, principal components analysis might have allowed me to reduce the large number of dimensions for each construct into a smaller set of summary variables, which were measuring the same underlying dimension; "these underlying dimensions are known as factors or latent variables" (Field, 2000, p. 423). For example, performance improvement, productivity increases, effectiveness enhancements, and system usefulness might have all been measuring usefulness.

The scores for the independent and dependent variables were arrived at by calculating the average score of the results of the survey questions for each variable. For example, suppose a participant responded to the four questions pertaining to the independent variable, perceived usefulness, with the following values: +2 (*strongly agree*), +1 (*agree*), 0 (*neutral*), and +2. Also, I assumed that these four responses can be grouped together, as supported by previous research. To construct the independent variable value for perceived usefulness, the mean of these values was calculated; therefore, +1.25 was to be used in the data analysis for the perceived usefulness value for this participant. "The scales were arrived at by determining the average score of the items for each construct" (Venkatesh & Davis, 1996, p. 456). Therefore, using the mean to calculate the values of the independent and dependent variables for each construct in this study was supported by the theorists of the TAM.

The reliability of the survey instrument in Appendix A was validated. The reliability of a similar survey instrument was validated by Venkatesh and Davis (2000); they provided measurement scales and reliabilities for the three main constructs of the TAM:

Intention to Use

(Cronbach's α ranged from 0.82 to 0.97 across studies and time periods)

Perceived Usefulness

(Cronbach's α ranged from 0.87 to 0.99 across studies and time periods)

Perceived Ease of Use

(Cronbach's α ranged from 0.86 to 0.98 across studies and time periods) (p. 201)

The survey questions in Appendix A focusing on these concepts used similar language. However, Cronbach's alpha α was calculated for each construct; values of over 0.80 helped to confirm that the questions were reliable. The combination of Cronbach's alpha calculations and factor analysis mitigated concerns about measure reliability or validity (Venkatesh & Davis, 2000).

The scores of similar questions were calculated using a coded numeric value for each possible response. Ordinal data have no indication of quantity; rather ordinal data are used for ranking order (Davies & Mosdell, 2006). Therefore, for all questions which used the Likert scale, ordinal data were assigned to the scale as follows: +2 represents *strongly agree*, +1 represents *agree*, 0 represents *neutral*, -1 represents *disagree* and -2 represents *strongly disagree*. On the other hand, nominal data represent numbers that are assigned to represent an attribute (Davies & Mosdell, 2006); for example, the code 1 represented *female*, code 2 represented *male*, and code 3 represented *prefer not to mention* for the gender question. All the questions in the survey were coded similarly.

To further increase the validity of the survey instrument, an expert panel consisting of at least three professionals working at the college district reviewed and commented on the questionnaire. These individuals included a researcher, a math professor, a Blackboard expert, and a professional who has managed several clinical trials. They checked the question wording, the instructions given to the students, the presentation of the survey, and the protection of the students (Davies & Mosdell, 2006).

For example, this team determined if the questions will capture the required data by asking: "is each question asking exactly what you want it to?" (Davies & Mosdell, 2006, p. 108). This expert panel suggested rewording questions, adding questions, and deleting some irrelevant questions. The final survey in Appendix A incorporated their comments.

Davies and Mosdell (2006) stress the "*vital* stage" of piloting the questionnaire (p. 108). Once the expert panel checked the questionnaire as described above, a real test of the survey instrument was recommended. Therefore, a pilot study of approximately twenty students who fit the desired sample was conducted after IRB approval. I randomly selected one course ticket number from the sampling frame for this pilot study; this course ticket number was excluded from the sampling frame that will be used in the actual survey. This pilot survey used the same survey tool as the final survey to help identify any problems with the administration and implementation of the survey. The students received an e-mail invitation specific for the pilot study (see Appendix B). The survey link showed the same consent form as the actual survey, followed by the actual survey (see Appendix C and Appendix A, respectively).

In addition to checking the survey instrument, the pilot results helped in checking the coding and the findings (Davies & Mosdell, 2006). Checking the coding might identify problematic questions that may need to be reworded. Sometimes, the pilot findings lead to adding questions or deleting some irrelevant questions in the final version. If changes needed to be made based on the pilot, I would have submitted a Request for Change in Procedures form for IRB approval. The pilot data were entered into SPSS and analyzed using the same statistical measures as the actual survey results.

This pilot study helped to ensure reliability, construct validity, external validity, and internal validity.

The external validity (or generalizability) of the results may be threatened if there is a systematic difference between the respondents and the nonrespondents to the survey (Tashakkori & Teddlie, 2009). Every precaution was taken to make sure that the respondents represent a wide cross section of the students at the district. This assured that the participants were representative of the population (Davies & Mosdell, 2006). Once the final data were available, I compared the demographics of the participants were to the district student demographic data to help ensure external validity.

Internal validity ensures that the findings are reliable because the researcher has eliminated all possible sources of error in designing the study (Davies & Mosdell, 2006). Problems with subjects, demand characteristics, and replication may cause issues with internal validity. The research design, the expert panel review, and the pilot study helped to achieve internal validity in this study to the extent possible.

The participants of the web survey needed to follow a simple process to complete the survey. An e-mail inviting the student to participate in the survey was sent to the sample population because "responses to online surveys are greatest when respondents are first contacted by e-mail" (Sue & Ritter, 2007, p. 5). Upon receipt of this e-mail (see Appendix B), the student could choose to click the link to go to the consent form and the survey; if he or she chose not to participate in the survey, he or she could simply ignore the e-mail. Once the participant clicked the link to start the survey, a consent form (see Appendix C) introduced the survey, the procedure, voluntary nature of the study, risks

and benefits of being in the study, confidentiality, contacts, and statement of consent. Each set of questions were displayed at one time on the screen. After the completion of the survey, a message thanking the participants for their participation was displayed.

The survey tool, SelectSurvey.NET, offered the functionality to create questions and export data in a variety of formats. First, a survey was created using the default template; then the survey questions and answers were entered. Security for these users was set so that the survey responses were anonymous. The college district provided the e-mail addresses of the sample population. I sent the e-mail invitations and follow-up requests to the sample. This survey tool provided a variety of export formats, including Microsoft Excel and SPSS Extended; both were used to efficiently enter data into SPSS. The survey instrument and survey tool are described in detail, as well as the data that comprised each variable in the study. A discussion of the data collection and analysis follows.

Data Collection and Analysis

Through the electronic questionnaire, I collected quantitative data representing participant demographic data and perceptions of and intent to use the Blackboard Mobile Learn application. Tashakkori and Teddlie (2009) stated that "when questionnaires are used in a study, the researcher is employing a strategy in which participants use self-report to express their attitudes, beliefs, and feelings toward a topic of interest" (p. 232). Closed-ended quantitative questionnaires, such as the one used in this study, are used more frequently than open-ended qualitative questionnaires due to their efficiency in data collection and analysis (Tashakkori & Teddlie, 2009).

The web-based survey tool from the college district, SelectSurvey.NET, provided raw data in a database format. The data were cleaned to verify the data file was complete and error-free to the extent possible. Fowler (1988) suggested that "every field should be checked to make sure that only legal codes occur" (p. 134). To verify that only students who were eligible participated in the survey, the data were reviewed. The data were imported into SPSS to assist in performing the data analysis. The scores for each question were calculated using a coded numeric value for each possible response.

The quantitative data analysis consisted of both descriptive and inferential analysis with the assistance of SPSS version 19. Descriptive statistics were used to describe the data. "Descriptive statistical analysis refers to the analysis of numeric data for the purpose of obtaining summary indicators that describe a sample, a *population*, or the relationships among the variables in each" (Tashakkori & Teddlie, 2009, p. 333). For example, a table of the frequency distribution and percentages for the responses to the demographic questions was included. I compared the demographics of the participants to the district student demographic data to help ensure external validity.

I conducted inferential analysis to test the hypotheses. For the first set of hypotheses, I used multiple linear regression analyses to explore the relationship between the independent variables, perceived usefulness and perceived ease of use, and the dependent variable, intent to use. Multiple regression analyses can be used to predict an outcome, the dependent variable, from several predictors, the independent variables (Field, 2000). "This is an incredibly useful tool because it allows us to go a step beyond the data that we actually possess" (p. 103). For the first set of hypotheses in this study,

multiple linear regression analyses was used to test if significant relationships exist between the outcome, intent to use the mobile app, from two predictors, perceived usefulness and perceived ease of use. Similarly, MANOVA, multivariate analysis of variance, is well suited for correlations but not for predictive modeling. Discriminant function analysis is linked to both multiple regression and analysis of variance.

> Discriminant function analysis can be used both to predict the group to which a person or 'case' might belong on the basis of a set of characteristics which that person or case holds, and to identify which variables are most powerful in distinguishing between the members of different groups. (Sapsford & Jupp, 1996, p. 275)

In this study, the participants belong to just one group, the students who have access to the web-based Blackboard Learn. A future study may use discriminant function analysis to predict the group in which a student may belong; one group of students may favor the web-based application, and another group may favor the mobile application. Thus, MANOVA and discriminant function analysis were not the best type of analysis for this type of study. Factor analysis was used for construct validity, but not for hypotheses testing. According to scholarly literature, multiple regression was the preferred data analysis technique for TAM based research (Friedrich & Hron, 2010; Halawi & McCarthy, 2007; Venkatesh & Davis, 1996, 2000).

In addition, a 3-D scatterplot was drawn to visualize the linear regression model with intent to use as the y-axis, perceived usefulness as the x-axis, and perceived ease of use as the z-axis. If the multiple regression analyses indicated there was no relationship

between the dependent variable and both the independent variables, then no further analysis was conducted to test the first set of hypotheses. If there was a relationship, then additional analysis was done for each independent variable separately. As an example, a regression analyses was conducted to examine the relationship between perceived usefulness and intent to use. In addition, the coefficient of determination (R^2) was calculated to determine the percentage of variation in intent to use Blackboard Mobile Learn accounted for by the perceived usefulness (Aczel & Sounderpandian, 2009). Furthermore, a separate test for multicollinearity was conducted between the two independent variables: perceived usefulness and perceived ease of use. Aczel and Sounderpandian stated that "the reason multicollinearity (or simply *collinearity*) has such a pervasive effect on multiple regression is that whenever we study the relationship between Y and several X_i variables, we are bound to encounter some relationships among the X_i variables themselves" (p. 531). Researchers hope for no multicollinearity; however, sometimes, data indicate that the variables are perfectly collinear (Aczel & Sounderpandian, 2009).

For the second set of hypotheses, I tested it using t tests for population means where the variances are unknown to explore the students' intent to use specific functions of the mobile application. According to Aczel and Sounderpandian (2009), "when the null hypothesis is about a population mean, the test statistic can be" t, "if the population is normal and σ is unknown but the sample standard deviation S is known" (p. 272). From the data, the sample standard deviation S was calculated. The test statistic Z could also be used for these hypotheses about population means; however, the formula to

calculate Z requires the value for the population standard deviation σ; in this study, because the population standard deviation σ was unknown, the Z test statistic was not used. I tested the null hypotheses at an alpha α of 5%.

The presentation of the results included tables and figures, as appropriate. I also included the descriptions of the results. Chapter 4 presents the findings of the study.

Protection of Participants' Rights

An important concern of researchers is the anonymity and confidentiality of the data provided by the participants of the study. This study involved a web-based survey that was conducted on a voluntary basis by 2-year college students who were adults. The protection of participants' rights is first depicted in the invitation e-mail (see Appendix B); this e-mail assured the participants that the survey was voluntary and anonymous. The invitation urged adults (age of 18 years old or above) to participate in the study.

The protection of participants' rights is further detailed in the survey questionnaire consent form (see Appendix C). This consent form introduced the survey, procedures, voluntary nature of the study, risks and benefits of being in the study, confidentiality, contacts, and statement of consent. The procedure section reiterated that only adults, age 18 years old or above, were eligible to participate in the study. The participants were also reminded to complete the survey just once, even if they received multiple e-mail invitations.

The voluntary nature of the study affirmed that no one would disrespect the students or treat them differently if they decided not to participate in the study. The consent form also reminded the participants that they could stop the study at any time.

There are no known risks of any kind associated with taking this survey. The participants were asked about their perceptions and use of a mobile application, in addition to demographic data. The risks section also advised the participants that permission for this survey is obtained from the college district. The letter of cooperation from the college district gave me the authorization to conduct this research study. This letter was signed by the vice chancellor of Technology and Learning Services, who also oversees the college district's Research and Planning Office.

There was no compensation for being a participant in the study. The participants were reminded that their participation was completely anonymous. The participants were also told that the survey results will be reported in the dissertation or related articles in an aggregate fashion. Measures to ensure anonymity of the participants included creating an identification number for each participant. Because this was a web-based survey, I did not know the identity of the participants. The raw data were exported from the survey tool SelectSurvey.NET and transferred to two of the researcher's USB (Universal Serial Bus) flash drives for safe-keeping and backup. The backup copy is kept at a different location. For data disposal, the USB drives with the data will be securely erased (all files deleted) after a period of five years.

If the participants have any questions or concerns, they can contact me via phone or e-mail. They can also contact a Walden University representative regarding their rights as a participant. The research participants and community stakeholders may go to the following website to download the approved dissertation, which will be available for a period of four months: http://www.rmathurweb.com/phd/. A statement in the invitation

e-mail and the consent form stated that completion of the survey gave informed consent to participate in the study (Thomas, 1999). This implied consent from all participates who completed the survey indicated that they understood the risks involved. Approval from Walden University's Institutional Review Board (IRB) was received. The e-mail invitations, consent form, letter of cooperation, and survey accompanied the IRB proposal. No data were collected until approval was obtained from Walden University's IRB. Walden University's approval number for this study is 03-02-11-0125170 and it expires on March 1, 2012.

Summary

The quantitative research design was used in this study to investigate students' perceptions of a CMS mobile application. The survey research with a cross-sectional design was appropriate in gathering quantitative data on attitudes and perceptions. The setting of two community colleges in southern California provided an adequate sample of over 500 students who had access to the web-based Blackboard Learn. I designed the survey instrument based on the key constructs provided by research articles using the TAM; this added reliability and validity to the questionnaire. An e-mail invitation was disseminated to the sample population, with a link to the web-based survey. I used SurveySelect.NET, available from the college district, to administer the web-based survey. I collected and analyzed the data with the help of SPSS. I used both differential and inferential statistics to analyze the data and draw conclusions. Participation was anonymous and the participants were protected from harm. IRB approval commenced the process of data collection.

Chapter 4 describes how the study was conducted, how the data analyses were performed, and the findings. Finally, a presentation of the conclusions and recommendations are included in chapter 5.

Chapter 4: Results

The data analyses and results are presented in this chapter. The first sections include a discussion of the research tool, the pilot study, and the data collection, which includes the response rate. The data analyses sections include descriptive statistics of the demographic data, reliability and principal components analysis, regression analyses, and the population mean analyses. The findings and summary sections conclude the chapter.

Research Tools

I used the web-based survey tool SurveySelect.NET. After the survey was stopped, I exported the raw data from SurveySelect.NET in SPSS condensed format as a CSV (comma separated values) file. This file was opened in Microsoft Excel to add a new field for the case identification number. This file was saved as a Microsoft Excel format (.xlsx). In SPSS version 19, the survey data file was opened directly from the Microsoft Excel format to minimize touching the survey data. The survey data file was then saved in SPSS data format (.sav); the detailed variable definitions, such as the name, label, value, and missing parameters, were modified for each of the variables. Next, the computed variable, dvc_4BBML, was calculated using SPSS. The value of this variable was one if the respondent uses a mobile device capable of running Blackboard Mobile Learn, such as an iPhone, iPad, iPod Touch, Blackberry, or Android smartphone; otherwise, the value was zero. The data were analyzed by using SPSS software version 19.0. For this study, an alpha level α of 0.05 was used for all statistical analyses.

Pilot Study

A pilot study was conducted to assess the survey instrument and the consent form (see Appendix A and C, respectively). In the Spring 2011 semester, a randomly selected course that used the web-based Blackboard Learn at one of the colleges was involved in the pilot study. After IRB approval, an e-mail invitation requesting participation for the pilot study (see Appendix B) was sent to all 31 students in the course Criminal Law I, from the School of Social and Behavioral Sciences. Blackboard Connect was not available from the district to send the e-mail to the students; therefore, I sent the e-mail invitation. The same process was done for the actual survey. If the students volunteered to participate, a link in the e-mail invitation took them to a website with the consent form, followed by the pilot survey, both of which were identical to the actual survey.

The response rate was 9.7%, which was lower than the 15% assumed response rate used to determine the number of surveys to send for the actual research. The participants took the survey within 1 or 2 days after receiving the e-mail invitation, even though the pilot survey was available for 1 week. Perhaps a follow-up e-mail for the pilot study would have increased the response rate. Thus, for the actual survey, the follow-up e-mail helped to serve as a reminder and increased the number of participants. The pilot study participants took an average of 3 minutes to read the consent form and complete the survey. These 3 minutes represented the expected time frame; hence, the actual e-mail invitation that stated “about five minutes” was not changed (see Appendix B).

The pilot data were retrieved correctly from SurveySelect.NET using the SPSS Format Condensed export option. The exported file in comma separated values (CSV) format was then opened in Microsoft Excel to add the identification column. The pilot data were then imported into SPSS version 19 for the data analysis. No problems with the coding were found. Also, there were no issues with the administration and implementation of the e-mail invitation, consent form, and survey instrument. The success of the pilot study indicated that no change to the survey instrument, the consent form, or the administration of the survey was required.

Data Collection

For the actual study, the college district provided a list of all course sections at both colleges that used Blackboard Learn during the Spring 2011 semester; this list contained 1,547 course sections. SPSS was used to randomly select 25 course sections. I sent an e-mail invitation to all students enrolled in the 25 course sections. The number of students enrolled in these 25 course sections was 952; therefore, all 952 students were sent the e-mail invitations. Some students might have been enrolled in multiple courses, thereby receiving more than one invitation e-mail; however, the invitation e-mail and the consent form requested the students to complete the survey just once. Incidentally, I did not teach any of the 25 courses in the sample, although some of my students might have been in other courses and received the e-mail invitation. The survey was anonymous, so I did not know the identity of the participants.

The survey was open for 2 weeks; a follow-up e-mail was sent 3 days prior to the closing of the survey thanking those who had already participated and encouraging those

who had not completed the survey to do so. The number of participants who completed the survey was 98, resulting in a response rate of 10.3%. This final response rate was lower than the assumed response rate of 15%. However, the number of participants was higher than the minimum required sample size of 68 students. Appendix D lists the actual survey data received from the 98 participants.

The data were cleaned for abnormalities. The data were examined to verify whether the eligibility requirement for the minimum age of the participants to be 18 years old was met. Three participants indicated their age was below 18 years old, which made them ineligible to partake in the survey. Hence, the records of these three participants were removed from the data prior to data analysis, leaving a total of 95 records.

Missing values in the data were constrained because all the questions in the web-based survey were marked as required in the survey tool. The participants could not move to the next page in the web-based survey unless they answered each of the questions on the web page; if they tried to skip a question, a warning message popped up requesting them to respond to the unanswered questions. In addition, many of the demographics questions included a possible response of prefer not to mention, which could have been used as a way to skip a question. The questions pertaining to student perceptions and intentions were all required with no prefer not to mention option. The consent form stated that the participants could stop the survey at any time. Controlling missing values by using either prefer not to mention or allowing the students to stop the survey at any time may not be the preferred method for some participants. This

limitation of the study was noted in the Assumptions, Limitations, Scope, and Delimitations section in chapter 1.

With the cleaned dataset of 95 records, there were three cases of missing data, where the participants did not answer questions related to their perceptions and intentions of Blackboard Mobile Learn. These participants stopped the survey early, responding to only the demographic Questions 1-7. Due to the fact that the data for these three participants did not contribute any information to answering the research questions of this study, these three cases were also removed from the data prior to data analysis, leaving a total of 92 valid records.

Another four participants did not complete Questions 18-24, which focused on the intentions to access each of the specific functions, but they did complete Questions 1-17, which included the demographic questions and the perceptions and intentions of the mobile application. Consequently, the data from these four participants were available to help answer the first research question, but the data were missing for the second research question. Due to the importance of the information provided by these four participants for the first research question, these four cases were not removed from the data at this stage. The compartmentalization of these data and the different data analysis techniques allowed for the first research question to use a sample size of 92 records, and for the second research question to use a sample size of 88 records. Descriptive data analyses were performed on the demographics data first, followed by the remaining items on the questionnaire.

Descriptive Statistics

Descriptive statistics were used to describe the data and illustrate the distribution of the data. The central tendencies of mean, median, and mode were examined. The dispersion indicators of standard deviation, variance, range, minimum, maximum, and standard error of the mean were inspected. The skewness and kurtosis of the distributions were observed. In addition, histograms were observed with the normal curve superimposed. The crucial values of the descriptive statistics are discussed below.

Descriptive Statistics of the Demographic Data

The demographics of the participants were compared to the district student demographic data to help ensure external validity and a cross-sectional design. The gender statistics from the study were similar to the district numbers (see Table 2).

Table 2

Demographic Information: Gender

Gender	*f*	%	College district %[a]
Female	54	59	57
Male	36	39	42
Prefer not to mention	2	2	1
Total	92	100	100

Note. [a]Adapted from "College Profile Report Spring 2011" by Mathur County Community College District, 2011, retrieved March 9, 2011, from https://sharepoint.mathur.edu/sites/dw/abhay/default.aspx.

Using the cleaned data, the age of the participants varied from 18 years old to 65 years old (see Table 3). These numbers were consistent with the district student demographic numbers that show a high concentration of students from age 18 to 29 (Mathur County Community College District, 2011).

Table 3

Demographic Information: Age Group

Age group	*f*	%
Below 18 years old	0	0
18 to 25 years old	55	60
26 to 35 years old	20	22
36 to 45 years old	8	9
46 to 55 years old	4	4
56 to 65 years old	3	3
Above 65 years old	0	0
Prefer not to mention	2	2
Total	92	100

The participants were enrolled in either college or both colleges for the Spring 2011 semester (see Table 4). An admitted student enrolled at one college can take courses at the other college because both are part of the same college district. The actual district student head count was similar.

Table 4

Demographic Information: College

College	*f*	%	College district %[a]
Abhay College	29	32	31
Swaril College	50	54	62
Both	13	14	7
Total	92	100	100

Note. [a]Adapted from "College Daily Term Comparison Report Spring 2011" by Mathur County Community College District, 2011, retrieved March 9, 2011, from https://sharepoint.mathur.edu/sites/dw/abhay/default.aspx.

The e-mail invitation was sent to a sample of 25 course sections that used the web-based Blackboard Learn. Out of the 25 course sections that comprised the sample of the survey, nine (36%) were courses from one college, while the remaining 16 (64%) were courses from the other college. The sample of 25 course sections was from a

variety of schools (see Table 5). The frequencies of courses in the sample from the School of Business Sciences (20%) and the School of Social and Behavioral Sciences (52%) seemed high; hence, they were compared to the population parameters. In the population of 1,547 course sections that used Blackboard Learn, 12% were from the school of Business Sciences, and 23% were from the School of Social and Behavioral Sciences. The sample percentages still seemed high; however, the sample of 25 course sections were obtained using the random select cases function in SPSS. Furthermore, the 25 courses titles in the sample were different, except for two courses each from Financial Accounting, Psychological Aspects of Human Sexuality, and Social Psychology. There was not a concentration of courses from computer or engineering that had the potential to create a bias in the data because these students might be more inclined to use new technology, such as the recently released Blackboard Mobile Learn application. The survey data were not biased due to the high percentages of the courses from a particular school; therefore, the sample of 25 course sections data was not altered.

Table 5

Demographic Information: Schools

School	*f*	%
Business Sciences	5	20
Fine Arts	2	8
Health Sciences & Human Services	1	4
Humanities	1	4
Liberal Arts	2	8
Math, Science, and Engineering	1	4
Social and Behavioral Sciences	13	52
Total	25	100

The student participants indicated a high level of familiarity with using computers (see Table 6). In fact, 97% of the students had been using a computer for more than 3 years.

Table 6

Demographic Information: Years Using a Computer

Years using a computer	*f*	%
Less than 1 year	0	0
1 to 3 years	2	2
4 to 6 years	10	11
More than 6 years	79	86
Prefer not to mention	1	1
Total	92	100

Blackboard Learn is the web-based CMS application used on personal computers or laptops. Sixty-nine percent indicated they had been using Blackboard Learn for more than one year (see Table 7). It was expected that students who had been using Blackboard Learn for more than one year would be more interested in using the mobile application, Blackboard Mobile Learn. On the contrary, 32% had been using Blackboard Learn for less than one year; this percentage was higher than expected. This data of Blackboard usage might indicate that due to the economic slowdown, new students are returning to the community colleges, possibly for retraining, job advancement, or job security.

Table 7

Demographic Information: Years Using the Web-Based Blackboard Learn

Years using Blackboard Learn	*f*	%
Less than 1 year	29	32
1 to 3 years	46	50
4 to 6 years	15	16
More than 6 years	2	2
Prefer not to mention	0	0
Total	92	100

The participants were asked to select all the types of devices they use; they could select more than one (see Table 8). The results confirmed that students are still using both desktops and laptops. The six students who responded that they use a netbook also responded that they use a laptop; hence, they might consider a netbook a type of laptop. Only 11% use an iPad; this small percentage is understandable because the iPad was just released 11 months prior to the survey. Fifty-seven percent use a smartphone, such as an iPhone, Android, or BlackBerry. The results indicated that only a few students, 4%, use an e-book reader, such as the Amazon Kindle or Barnes and Noble's Nook. An option of *none of the above* was also listed for this question on the types of devices used; but, no participants chose this option. This verified that the list of mobile devices on this question was thorough at the time of this survey. The results in Table 8 indicated that most students use multiple devices. This data on the types of devices students use and how the students use not just one, but multiple devices, is useful for college administrators and professors as they design and implement student tools, such as Blackboard Mobile Learn.

Table 8

Demographic Information: Types of Devices Used

Types of devices used	*f*	%
Desktop personal computer	64	70
Laptop	76	83
Netbook	6	7
iPad	10	11
iPhone	24	26
iPod Touch	17	19
Android smartphone	17	19
BlackBerry smartphone	11	12
Other mobile phone/device	14	15
e-book reader	4	4
None of the above	0	0

Note. $N = 92$.

In a previous study by Diamanduros et al. (2007), the results indicated that 84% owned either a laptop or desktop computer, with about equal division between laptops and desktops, 35% owned either an Mp3 player or an iPod, 98% owned a cell phone, 10% owned a PDA, 2% owned a Blackberry, and 22% had a landline. An interesting fact was that 53% owned three or more devices, 33% owned two devices, and only 14% owned a single device (Diamanduros et al., 2007). As noted above, I also inquired about students' technology ownership in my study; I included other devices, such as iPhones or other smart phones, iPod Touch, iPad or other similar tablets, and e-book readers.

Blackboard Mobile Learn was available on the following devices at the time of the survey: iPad, iPhone, iPod Touch, Android smartphone, and BlackBerry smartphone. It was calculated that 54 participants (58.7%) use at least one mobile device on which this mobile application was available. Twenty-one participants stated they use the mobile application Blackboard Mobile Learn. Therefore, out of the participants who use devices

on which Blackboard Mobile Learn was available, 39% use the mobile application at the time of the survey. Taking into consideration that this mobile application was released for the students just 3 months prior, the usage rate was higher than expected.

Descriptive Statistics of the Perceptions of Blackboard Mobile Learn Data

For the first research question, the predictor and outcome variables were grouped according to the scales for perceived usefulness, perceived ease of use, and intent to use. In the next sections, construct validity and reliability of these scales are tested. In this study, the 5-point Likert scale was used, with the following values: +2 (*strongly agree*), +1 (*agree*), 0 (*neutral*), -1 (*disagree*) and -2 (*strongly disagree*). The mean, standard deviation, and variance for the questions related to the independent variables, perceived usefulness and perceived ease of use, and the dependent variable, intent to use, are listed in Table 9. The median, mode, range, minimum, maximum, and standard error of the mean were also examined. The skewness and kurtosis of the distributions were observed, in addition to the histograms with the normal curve superimposed.

Table 9

Statistics for the Items Related to the Independent and Dependent Variables

Variable	*M*	*SD*	Variance
Perceived Usefulness			
Improves performance	0.45	1.09	1.20
Increases productivity	0.49	1.12	1.26
Useful	0.80	0.91	0.82
Enhances Effectiveness	0.43	1.02	1.04
Perceived Ease of Use			
Clear and understandable	0.87	0.85	0.73
Easy to do what I want it to do	0.63	1.05	1.09
Easy to use	0.72	1.00	1.00
Does not require a lot of mental effort	0.74	1.06	1.12
Intent to Use			
Intend to use	1.10	1.00	0.99
Predict using it	0.99	1.08	1.18

Note. $N = 92$.

An initial review of the mean for all the questions related to perceived usefulness indicated that students rated them between neutral and agree. An initial review of the mean for all the questions related to perceived ease of use indicated that students rated them between neutral and agree. An initial review of the mean for all the questions related to the dependent variable, intent to use, indicated that students rated them close to agree.

The mean, standard deviation, and variance for the questions related to the intent to use specific functions of Blackboard Mobile Learn are listed in Table 10. These data helped to answer the second research question. The sample size for these questions was 88 with a total of four missing cases, as noted earlier. An initial review of the mean for all these items indicated that students rated them close to agree. Surprisingly, the discussions function ranked the lowest, with a mean of 0.52, which is between neutral

and agree. The mean for the My Grades function ranked the highest, with a mean of 1.30, which is between agree and strongly agree.

Table 10

Statistics for the Intent to Use Specific Functions

Specific functions	*M*	*SD*	Variance
Announcements	1.10	1.01	1.10
Information	0.97	1.10	1.21
Contacts	0.92	1.15	1.32
Discussions	0.52	1.22	1.49
My Grades	1.30	0.95	0.90
Assignments	0.97	1.14	1.30
Documents	0.92	1.11	1.22

Note. $N = 88$.

Descriptive statistics provided a good basis for exploration of the data. It also supported the cross-sectional design chosen for this study. No critical issues were found during descriptive statistical analysis. Inferential analyses were conducted to test the hypotheses. However, before inferential analyses were begun, the scales of the predictor and outcome variables were tested for validity and reliability.

Principal Components Analysis

The scales for perceived usefulness, perceived ease of use, and intent to use were based on similar scales used by TAM researchers (Venkatesh & Davis, 1996, 2000). These TAM researchers also acknowledged the validity and reliability of these scales across many studies and time periods (Venkatesh & Davis, 2000; Venkatesh et al., 2007). In this study, principal components analysis using direct oblimin rotation was run on the factors pertaining to the independent and dependent variables, with the sample size $N = 92$. To further support the use of principal components analysis with direct oblimin

rotation, Venkatesh and Davis (2000) used this same analysis to report strong construct validity for their TAM study. The analysis results attempted to confirm whether the constructs of this study identically matched the constructs of the TAM.

A preliminary analysis of the data for the questions related to the independent and dependent variables, Questions 8-17, showed that all the questions correlated fairly well with all others and none of the correlation coefficients were particularly large; therefore, there was no need to eliminate any questions at this stage. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (KMO = 0.88) was acceptable. In addition, Bartlett's test of sphericity was highly significant ($p < 0.001$). Therefore, factor analysis was deemed appropriate for these data based on the preliminary analysis.

The factor extraction process first determined the eigenvalues of the R-matrix. The eigenvalues associated with each linear component before extraction and after extraction was calculated using SPSS (see Table 11). Factor 1 explained 62.93% of the total variance, whereas factor 2 explained 9.93% of the total variance. Only one factor was extracted according to Kaiser's criterion. The scree plot also supported this extraction of only one component. The solution could not be rotated because only one factor was extracted.

Table 11

Eigenvalues Using Principal Component Analysis

Component	Initial eigenvalues		Extraction sums of squared loadings	
	Total	% of Variance	Total	% of Variance
1	6.29	62.93	6.29	62.93
2	.99	9.93		
3	.83	8.29		
4	.59	5.91		
5	.39	3.93		
6	.24	2.39		
7	.22	2.22		
8	.19	1.90		
9	.15	1.51		
10	.10	1.00		

Table 12 shows the list of communalities before and after extraction. Sixty-three percent of the variance associated with intent to use, Question 8, was common, or shared, variance. Similarly, 60% of the variance associated with clear and understandable, Question 9, was common variance.

Table 12

Communalities Using Principal Component Analysis

	Initial	Extraction
Intend to use	1.00	.63
Clear and understandable	1.00	.60
Improves performance	1.00	.61
Easy to do what I want it to do	1.00	.69
Increases productivity	1.00	.74
Easy to use	1.00	.61
Predict using it	1.00	.66
Useful	1.00	.74
Does not require a lot of mental effort	1.00	.30
Enhances Effectiveness	1.00	.73

Residuals were computed between the observed correlation coefficients and the reproduced correlations. There were 34 (75%) nonredundant residuals with absolute values greater than 0.05. According to Field (2000), "for a good model these values will all be small" (p. 462). Based on these findings, the data might not have been a good fit of the model as indicated by the large percentage of sizeable residuals (with absolute values greater than 0.05) as computed using principal component analysis (Field, 2000). There were grounds for concern whether the results of the principal component analysis should be used to dictate the construct of the variables in this study.

Principal components analysis is an exploratory tool. In this study, the results of this analysis extracted only one component and computed a large percentage of sizeable residuals. The sample size ($N = 92$) was small to gain useful results from the factor analysis. For factor analysis, the sample size is typically quite large (for example, 200 to 300). The results from this small sample size were used to gain as much insights as possible. Perhaps a larger sample size of a few hundred participants might have resulted in an extraction of three variables, in alignment with the TAM. There are other data analyses and documentation to support the validity and reliability for the constructs of the variables.

As noted in chapter 2, numerous studies based on the TAM reported strong construct validity for the independent and dependent variables: perceived usefulness, perceived ease of use, and intent to use based on questions similar to the ones used for this study. For example, the founders and proponents of the TAM, Venkatesh and Davis (2000), used principal components analysis with direct oblimin rotation to confirm strong

construct validity for their TAM study. The principal components analysis in this study did not extract three components as initially proposed; however, nothing in the data refutes the case for the measurement scales to be used as defined by the TAM. I continued with the data analysis using Cronbach's alpha to test the reliability of the measurement scales as supported by the TAM. I based the research questions of this study on the following constructs of these measurement scales (Venkatesh & Davis, 1996, 2000). The independent variable, perceived ease of use, was derived using the mean of the data from the following four statements from the web-based survey:

My interaction with Blackboard Mobile Learn would be clear and understandable.

Interacting with Blackboard Mobile Learn would not require a lot of my mental effort.

I would find Blackboard Mobile Learn to be easy to use.

I would find it easy to get Blackboard Mobile Learn to do what I want it to do.

The independent variable, perceived usefulness, was derived using the mean of the data from the following four statements from the web-based survey:

Using Blackboard Mobile Learn would improve my performance in my course(s).

Using Blackboard Mobile Learn in my course(s) would increase my productivity.

Using Blackboard Mobile Learn would enhance my effectiveness in my course(s).

I would find Blackboard Mobile Learn to be useful in my courses.

The dependent variable, intent to use, was derived using the mean of the data from the following two statements from the web-based survey:

Assuming I had access to Blackboard Mobile Learn, I intend to use it.

Given that I had access to Blackboard Mobile Learn, I predict that I would use it. To ensure reliability of these measurement scales, the following analysis using Cronbach's alpha was performed on the data.

Reliability of the Scales

The purpose of reliability analysis is to find out how consistently the selected variables gauge the construct. Cronbach's alpha assessed the reliability of the scales by examining consistency among the items. In this study, in order to ensure the reliability of the scales, I examined Cronbach's alpha of the scales (see Table 13).

Table 13

Cronbach's Reliability for the Independent and Dependent Variables

Variables	Cronbach's alpha α	Range of Cronbach's alpha α across studies and time periods[a]
Perceived Usefulness	0.93	0.87 to 0.99
Perceived Ease of Use	0.85	0.86 to 0.98
Intention to Use	0.92	0.82 to 0.97

Note. $N = 92$. [a]Adapted from "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies" by V. Venkatesh and F.D. Davis, 2000, *Management Science, 46*(2), p. 201.

All items for the independent variable, perceived ease of use, appeared to have good internal consistency, Cronbach's alpha $\alpha = 0.85$; hence, all four items appeared to be worthy of retention. Cronbach's alpha reliability measurement on the factor perceived usefulness indicated an alpha α of 0.93; hence, all four items for perceived usefulness appeared to be worthy of retention. All items for intent to use appeared to have good internal consistency, $\alpha = 0.92$; therefore, the two items appeared to be worthy of retention.

Therefore, the predictor and outcome variables of this study all have good internal consistency, with Cronbach's alpha values well above 0.7. The values for this survey instrument are in agreement with the Cronbach's alpha α calculated across TAM studies and time periods (Venkatesh & Davis, 2000). Based on the findings of this reliability test using Cronbach's alpha, the measurement scales for perceived usefulness, perceived ease of use, and intent to use, were measuring similar entities that are legitimate to compute together for the predictor and outcome variables. In other words, the internal consistency of the entities included in the components is sufficient to support the creation of the computed mean scale.

Due to establishment of the validity and reliability of the predictor and outcome variables, the variable values were computed using the mean. For every case, the mean of the four items related to perceived usefulness was calculated to create the value of the predictor variable, perceived usefulness. Similarly, the mean of the four items related to perceived ease of use was calculated to create the value of the predictor variable, perceived ease of use. The mean of the two items related to intent to use was computed to create the outcome variable, intent to use. The first and second research questions were explored using these variables, the calculated perceived ease of use, the calculated perceived usefulness, and the calculated intent to use.

Multiple Regression Analyses: Research Question 1

Inferential analyses were conducted to test the hypotheses. For the first set of hypotheses, I used multiple linear regression analyses to explore the relationship between the independent variables, perceived usefulness and perceived ease of use, and the

dependent variable, intent to use. Based on theory and prior TAM research, the forced entry multiple regression method was used. The hypothesis $H_0$1 postulated no linear relationship between the students' intent to use Blackboard Mobile Learn, and any of the independent variables, the students' perceived usefulness and students' perceived ease of use of Blackboard Mobile Learn.

Assessment of the Regression Model

An assessment of the regression model included evaluating two scenarios: (a) the fit of the regression model to the actual data, and (b) the generalization of the model to other samples (Field, 2000). In this study, I used casewise diagnostics to help identify three cases (3%) with standardized residuals greater than 2.5 (cases 50, 54, and 93); this percentage is higher than the 1% criterion noted by Field as being acceptable for a normally distributed sample. Therefore, the outliers in these data were a cause for concern, but further analysis helped to assess the influence of these outliers. A few influential cases can also bias the regression model; therefore, Cook's distance was used to identify the influence of particular cases on the model (Field, 2000). In this study, none of the cases had Cook's distance above 1; the three cases noted above with large standardized residuals (cases 50, 54, and 93) had Cook's distances of 0.15, 0.17, and 0.27, respectively. Therefore, none of the cases had undue influence on the regression model; so, no cases were removed.

In social research, it is imperative to produce generalizable findings. Assumptions for multiple regressions must be met in order to apply the results to the population, not just the sample. According to Field (2000), these assumptions include:

variable types, independence, non zero variance, predictors are uncorrelated with external variables, independent errors, no perfect multicollinearity, homoscedasticity, linearity, and normally distributed errors (pp. 128-129). Each of these assumptions is examined below.

For the variable types, the predictor variables must be quantitative (Field, 2000). Perceived usefulness and perceived ease of use were both measured at the ordinal level using the Likert scale; thus, they were quantitative and met this assumption. The outcome variable, intent to use, was also quantitative because it was measured at the ordinal level. The data for intent to use were not constrained, according to the definition provided by Field, as the data varied from -2 to +2, which is the entire range of the variable. Therefore, the assumption for the variable types was met. In addition to variable types, the assumption of independence of the outcome variable is tenable because each value of the outcome variable came from a separate participant (Field, 2000).

The predictors both showed some variation in value: the variance of perceived usefulness was 0.89 and the variance for perceived ease of use was 0.67; based on these results, the assumption of non zero variance was met. Another assumption is that the predictors are uncorrelated with external variables. External variables which influence the outcome variable, intent to use Blackboard Mobile Learn, may include socioeconomic status or instructor requirement to use the mobile app. The socioeconomic status variable would not correlate with the predictors of perceived usefulness and perceived ease of use. Similarly, the instructor requirement to use

Blackboard Mobile Learn would not correlate with the predictors. It was tenable that the predictors in this study are uncorrelated with external variables.

The assumption of independent errors was explored using the Durbin-Watson statistic. In this study, the Durbin-Watson statistic was 1.98; according to Field (2000), "the closer to 2 that the value is, the better" (p. 146). Based on the result, the assumption of independent errors is tenable.

Multicollinearity between the predictors can be a cause for concern when using regression. In this study, the predictors did not exhibit a perfect linear relationship; the correlation coefficient between perceived usefulness and perceived ease of use was 0.68 ($p < 0.001$). The correlation between perceived usefulness and perceived ease of use in this study is in line with prior research showing the close relationship between the constructs of perceived ease of use and perceived usefulness (Venkatesh & Davis, 2000). The variance inflation factor (VIF) "indicates whether a predictor has a strong linear relationship with the other predictor(s)" (Field, 2000, p. 132). In this study, the VIF of 1.84 was below the threshold of 10, indicating no cause for concern.

The assumptions of homoscedasticity and linearity were examined using Figure 1, the graph of standardized residuals (*ZRESID) against standardized predicted values (*ZPRED); this graph "should look like a random array of dots evenly dispersed around zero" (Field, 2000, p. 157). Figure 1 illustrated no curve in this graph, indicating that the assumption of linearity was met. The points on the graph formed the shape of a funnel, becoming more tapered across the graph. "This funnel shape is typical of heteroscedasticity" and indicated decreasing variance across the residuals (Field, 2000, p.

158). Based on this result, the assumption of homoscedasticity might be violated. The findings of the multiple regression analyses are noted with caution because of possible heteroscedasticity.

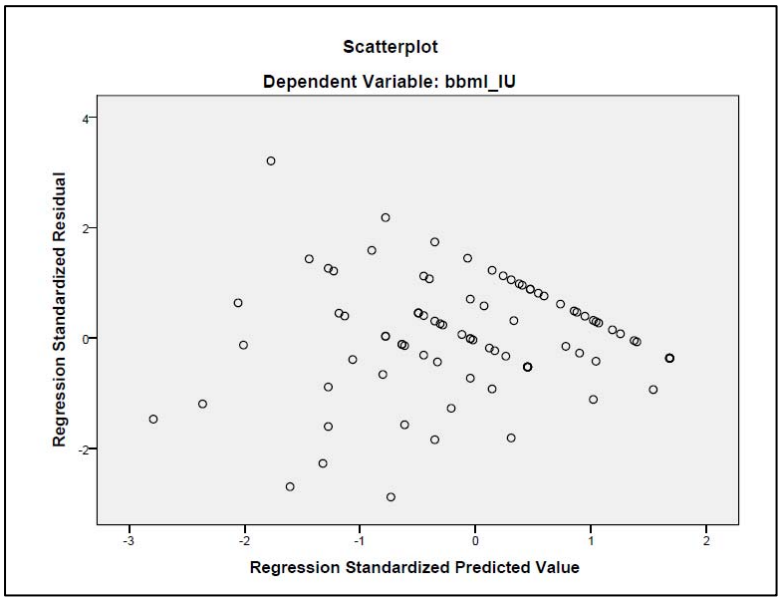

Figure 1. Plot of standardized residuals against standardized predicted values.

The histogram and the normal probability plots were used to test the assumption of normally distributed errors. The histogram illustrated a normal distribution (see Figure 2). The normal probability plot illustrates "deviations from normality", where "in a perfectly normally distributed data set, all points will lie on the line" (Field, 2000, p. 159). The normal probability plot of the data (see Figure 3) illustrates a slightly S-shaped curve, indicating uniformity and slight deviation from normality. However, the histogram in Figure 2 illustrated a strong normal distribution; therefore, the assumption of normal distributed errors was tenable.

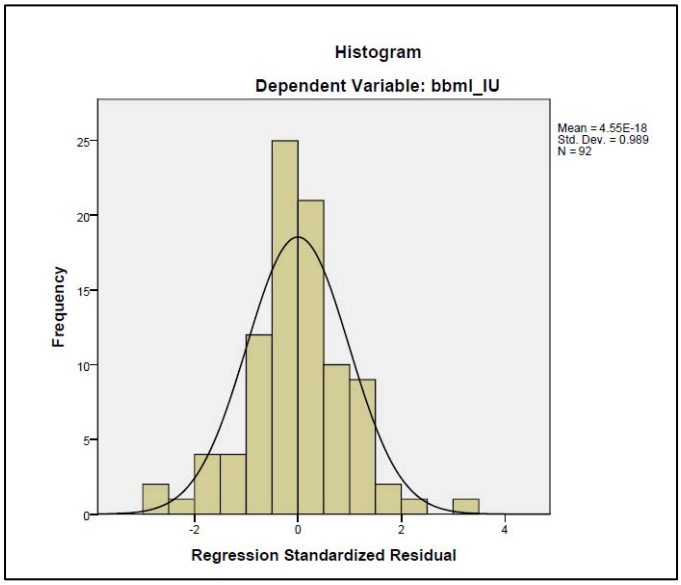

Figure 2. Histogram illustrating a normal distribution.

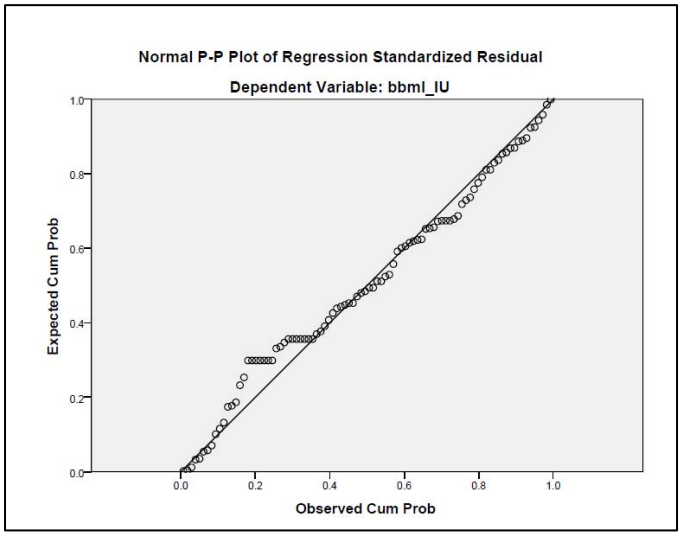

Figure 3. Normal probability plot of regression standardized residual.

In summary, the assumptions for multiple regressions were tenable, except for possible heteroscedasticity. Consequently, the results of the multiple regressions can be applied to the population, not just the sample, with caution.

Multiple Regression Model Statistics

Descriptive statistics for the computed predictor variables, perceived usefulness, and perceived ease of use, and for the computed outcome variable, intent to use, are shown in Table 14. The mean of the items for each scale resulted in the computed variables.

Table 14

Statistics for the Computed Independent and Dependent Variables

Variable	*M*	*SD*	Variance
Perceived Usefulness	0.54	0.94	0.89
Perceived Ease of Use	0.74	0.82	0.67
Intent to Use	1.04	1.00	1.00

Note. $N = 92$.

The Pearson correlation matrix gave an indication of the relationships between the predictor and outcome variables (see Table 15). There was a large positive correlation between the outcome variable, intent to use, and each of the predictor variables, perceived usefulness, $R = 0.68$ ($p < 0.001$), and perceived ease of use, $R = 0.64$ ($p < 0.001$). Therefore, the Pearson correlations inferred that the two predictor variables each had a positive relationship with the outcome variable. In addition, the two predictor variables, perceived usefulness and perceived ease of use, showed a large positive correlation, $R = 0.68$ ($p < 0.001$). Pearson correlations can be used for a preliminary look at multicollinearity. According to Fields (2000), "correlations of above 0.80 or 0.90"

may indicate multicollinearity (p. 132). Because the correlation between the two predictor variables was less than 0.7, there appeared to be no cause for concern regarding multicollinearity. This was further supported by the VIF, as examined earlier.

Table 15

Pearson Correlations Between the Predictor and Outcome Variables

	Intent to Use	Perceived Usefulness	Perceived Ease of Use
Intent to Use	1.00		
Perceived Usefulness	0.68***	1.00	
Perceived Ease of Use	0.64***	0.68***	1.00

Note: ***$p < .001$.

Multiple regression with forced entry of the two computed predictor variables, perceived usefulness and perceived ease of use, and the computed outcome variable, intent to use, was performed using SPSS. The overall model gave an indication of whether the model was successful in predicting intent to use Blackboard Mobile Learn. The multiple correlation coefficient between the predictors and the outcome variable was $R = 0.72$ (see Table 16). The coefficient of determination R^2 was .52; hence, the predictors, perceived usefulness and perceived ease of use, accounted for 52.3% of the variation in the outcome, intent to use Blackboard Mobile Learn.

Table 16

Multiple Regression Summary: Intent to Use From Two Predictors

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	.72	.52	.51	.70	1.98

It is prudent to investigate cross-validation by assessing how well the model can predict the outcome when a different sample is used (Field, 2000). The adjusted R^2 (0.51) was very close to R^2 (0.52); the difference was only 1.1%. Therefore, the model will reasonably predict the outcome when a different sample is used, establishing cross-validity and allowing for generalizations.

Multiple Regression Model Parameters

The results of the forced entry multiple regression analyses are shown in Table 17. The *F*-ratio was 48.76, which was significant (p <0.001); therefore, this model significantly improved the ability to predict the outcome variable, intent to use Blackboard Mobile Learn.

Table 17

Multiple Regression Predicting Intent to Use From Two Predictors

Variable	*B*	95% CI
Constant	0.48***	[0.29, 0.68]
Perceived Usefulness	0.48***	[0.27, 0.69]
Perceived Ease of Use	0.41†	[0.17, 0.65]
F	48.76***	

Note: $N = 92$. CI = Confidence Interval. ***$p < .001$. †p=.001.

The model obtained using the multiple regression coefficients was:

Intent to Use$_i$ = 0.48+(0.48 * Perceived Usefulness$_i$)+(0.41 * Perceived Ease of Use $_i$)

There was a positive linear relationship between perceived usefulness and intent to use Blackboard Mobile Learn. There was also a positive linear relationship between perceived ease of use and intent to use Blackboard Mobile Learn.

Based on the findings, the linear combination of the predictor variables can be used to predict the outcome variable. Recall that the null hypothesis was:

1. $H_0$1: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and any of the independent variables, students' perceived usefulness and students' perceived ease of use of Blackboard Mobile Learn.

This null hypothesis $H_0$1 was rejected due to the significant F-ratio.

Regression Statistics for Single Predictor

Given that this null hypothesis $H_0$1 was rejected, the following two subsidiary null hypotheses were tested:

a. $H_0$1a: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived usefulness of Blackboard Mobile Learn.
b. $H_0$1b: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived ease of use of Blackboard Mobile Learn.

First, the regression statistics for the single predictor, perceived usefulness, were evaluated. The t statistic for perceived usefulness was $t = 4.55$ ($p < .001$). The 95% confidence interval for perceived usefulness was [0.27, 0.69] (see Table 17). This confirmed that there was a positive linear relationship between perceived usefulness and intent to use Blackboard Mobile Learn. Therefore, the null hypothesis $H_0$1a was rejected because of the statistical significance of the results ($p < .001$).

Next, the regression statistics for perceived ease of use were evaluated. The t statistic for perceived ease of use was significant ($t = 3.40$, $p = .001$). The 95%

confidence interval for perceived ease of use was [0.17, 0.65] (see Table 17). This confirmed that there was a positive linear relationship between perceived ease of use and intent to use Blackboard Mobile Learn. Therefore, the following null hypothesis $H_0$1b was rejected because of the statistical significance of the results (p = .001). The results that explored the first research question are discussed. In the following section, the second research question is examined.

Population Mean Analyses: Research Question 2

For the second set of hypotheses, I tested it using *t* tests for population means where the variances are unknown to explore the students' intent to use specific functions of the mobile application. The *t* test was used here because the population was assumed to be normally distributed, the population standard deviation σ was unknown, and the sample standard deviation S was known (Aczel & Sounderpandian, 2009).

Recall that Table 10 listed the mean, standard deviation, and variance for the questions related to the intent to use specific functions of Blackboard Mobile Learn; the mean values are also shown in Table 18 and Table 19 for easy reference. The initial review of the descriptive statistics for most of the seven functions indicated that students rated them close to agree.

Table 18

Hypothesis 2: t Tests for Intent to Use Five Specific Functions

Specific Functions	*M*	*SD*	Test Value = +0.5		
			t	95% CI	Mean Difference
Announcements	1.10	1.01	5.62***	[0.39, 0.82]	0.60
Information	0.97	1.10	3.98***	[0.23, 0.70]	0.47
Contacts	0.92	1.15	3.44***	[0.18, 0.66]	0.42
Discussions	0.52	1.22	0.17†	[-0.24, 0.28]	0.02
My Grades	1.30	0.95	7.87***	[0.59, 1.00]	0.80

Note. $N = 88$. CI= Confidence Interval. ***$p < .001$. †$p = .431$.

Table 19

Hypothesis 3: t Tests for Intent to Use Two Specific Functions

Specific Functions	*M*	*SD*	Test Value = -0.5		
			t	95% CI	Mean Difference
Assignments	0.97	1.14	12.07†	[1.22, 1.71]	1.47
Documents	0.92	1.11	12.05†	[1.19, 1.65]	1.42

Note. $N = 88$. CI= Confidence Interval. †$p > .999$.

To test hypothesis 2, the *t* test for each of the five items was calculated, using a test value of +0.5 and 0.05 level of significance (see Table 18). The mean difference was calculated by subtracting the mean from the test value. These hypotheses denoted right-tailed tests that have the rejection region for H_0 on the right side of the normal distribution curve. The degrees of freedom *df* was 87 for all items. The second set of hypotheses was as follows; each of the specific null hypotheses was either rejected or not rejected:

2. The following null hypotheses state that students do not intend to use Blackboard Mobile Learn for these specific functions: Announcements, Information, Contacts, Discussions, and My Grades ($H_0$2: $\mu \leq +0.5$).
    a. $H_0$2a: Students do not intend to use Blackboard Mobile Learn for Announcements ($\mu \leq +0.5$). This null hypothesis $H_0$2a was rejected at a 0.05 level of significance (p-value < 0.001).
    b. $H_0$2b: Students do not intend to use Blackboard Mobile Learn for Information, which includes syllabus ($\mu \leq +0.5$). This null hypothesis $H_0$2b was rejected at a 0.05 level of significance (p-value < 0.001).
    c. $H_0$2c: Students do not intend to use Blackboard Mobile Learn for Contacts, which includes professor e-mail and office hours ($\mu \leq +0.5$). This null hypothesis $H_0$2c was rejected at a 0.05 level of significance (p-value < 0.001).
    d. $H_0$2d: Students do not intend to use Blackboard Mobile Learn for Discussions ($\mu \leq +0.5$). This null hypothesis $H_0$2d was not rejected at a 0.05 level of significance because of the large p-value = 0.431.
    e. $H_0$2e: Students do not intend to use Blackboard Mobile Learn for My Grades ($\mu \leq +0.5$). This null hypothesis $H_0$2e was rejected at a 0.05 level of significance (p-value < 0.001).
3. To test hypothesis 3, the t test for each of the two items was calculated, using a test value of -0.5 and 0.05 level of significance (see Table 19). The mean difference was also computed. These hypotheses denoted left-tailed tests that have the rejection region for H_0 on the left side of the normal distribution curve.

The degrees of freedom *df* was again 87 for all items. The following null hypotheses state that students intend to use Blackboard Mobile Learn for these specific functions: Assignments and Course Documents ($H_0$3: $\mu \geq -0.5$). There was reason to believe that students will avoid using their mobile devices to complete a quiz or read lecture notes.

a. $H_0$3a: Students intend to use Blackboard Mobile Learn for Assignments, which include homework, quizzes and exams ($\mu \geq -0.5$). According to the results of this left-tailed *t* test, this null hypothesis $H_0$3a was not rejected at a 0.05 level of significance (*p*-value > 0.999).

b. $H_0$3b: Students intend to use Blackboard Mobile Learn for Course Documents, which include main course content, lecture notes, or handouts ($\mu \geq -0.5$). According to the results of this left-tailed *t* test, this null hypothesis $H_0$3b was not rejected at a 0.05 level of significance (*p*-value > 0.999).

I explored the second research question using *t* tests for population means where the variances are unknown. The results confirmed the students' intent to use many of the specific functions of Blackboard Mobile Learn: Announcements, Information, Contacts, and My Grades. The findings were inconclusive for Discussions, Assignments, and Course Documents because the null hypotheses were not rejected.

Summary

This chapter reported the research tools and data collection techniques used to conduct the pilot study and the actual study. Descriptive statistics provided some exploration into the actual data, supporting the cross-sectional design of this study.

Principal components analysis was performed, but the TAM measurement scales for perceived usefulness, perceived ease of use, and intent to use were maintained. Cronbach's alpha confirmed the reliability of these scales. The first research question was examined using multiple regression analyses. Before multiple regression was performed, a thorough assessment of the regression model, including the assumptions, were examined and tenable. Regression with single predictor was also performed. The second research question was examined using the population mean analysis. The findings related to the hypotheses were presented. In chapter 5, I discuss the results, draw conclusions, and offer recommendations for further research.

Chapter 5: Discussion, Conclusions, and Recommendations

In this chapter, I first describe why and how the study was done. Next, I review the research questions, the hypotheses, and the findings of the research. The chapter concludes with the implications for social change and the recommendations for future studies.

Discussion of the Study

This study added to the research regarding student perceptions of mobile applications for course management systems (CMS). The rising appeal of mobile learning tools for students, coupled with budget constraints to offer such a service, has required more empirical evidence for college and university administrators to justify such service. Using a cross-sectional research design, I tested the linear relationship between students' perceived usefulness and students' perceived ease of use with their intent to use Blackboard Mobile Learn. The technology acceptance model (TAM) theorized that perceived usefulness and perceived ease of use would predict intent to use a system. In this study, I employed a web-based survey to sample 98 students at two local community colleges who were enrolled in a college course that used the web-based Blackboard Learn. The data from this cross-sectional survey were obtained at one point in time from a cross-section of the student population. The quantitative survey included 17 closed-ended questions based on a 5-point Likert scale, ranging from 1 (*strongly agree*) to 5 (*strongly disagree*), to rate the students' perceptions and intent to use regarding Blackboard Mobile Learn; it also included seven demographic questions. After data collection, the data analysis included descriptive statistics and inferential statistics; SPSS

version 19 provided assistance with the data analyses. To test the hypotheses, I used *t* tests for population means and multiple regression analyses, as discussed in the next section.

Interpretation of Findings

This study focused on the following research questions, as listed in chapter 1:

1. Is there a linear relationship between students' usage intentions of Blackboard Mobile Learn and their perceived usefulness and perceived ease of use of Blackboard Mobile Learn?
2. What specific functions of Blackboard Mobile Learn do students intend to use? The functions include Announcements, Information, Contacts, Discussions, My Grades, Assignments, and Course Documents.

Specific hypotheses related to each of these research questions were tested to address each of these research questions. For the first research question, the following hypotheses and results are reported below and in chapter 4.

1. $H_0$1: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and any of the independent variables, students' perceived usefulness and students' perceived ease of use of Blackboard Mobile Learn.

This null hypothesis $H_0$1 was rejected due to the significant *F*-ratio. The resulting multiple regression model showed a significant positive linear relationship between both perceived usefulness and perceived ease of use and the outcome variable, intent to use. This finding suggests that if students perceive Blackboard Mobile Learn to be useful and

ease to use, they will intend to use this mobile application. Therefore, the results support the TAM that is the theoretical framework of this study. Recall that according to TAM, intention to use is directly linked to actual usage behavior. Consequently, students will use Blackboard Mobile Learn because they intend to use it (Venkatesh & Davis, 2000). The findings of the multiple regression analyses are noted with caution because of possible heteroscedasticity. This study adds to the body of literature supporting TAM's extension as the multimedia acceptance model, as did the study by Saadé et al. (2007). This study successfully tested the TAM, as did a similar study using WebCT (Pan et al., 2005).

Given that this null hypothesis $H_0$1 was rejected, the following two subsidiary null hypotheses were tested:

a. $H_0$1a: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived usefulness of Blackboard Mobile Learn.
b. $H_0$1b: There is no linear relationship between the dependent variable, students' intent to use Blackboard Mobile Learn, and the independent variable, students' perceived ease of use of Blackboard Mobile Learn.

The null hypothesis $H_0$1a was rejected because of the statistical significance of the results ($p < .001$). The regression model indicated that there was a linear relationship between perceived usefulness and intent to use Blackboard Mobile learn. This finding suggested that, if students perceive that this mobile application is useful for their course work, they will intend to use it. The null hypothesis $H_0$1b was also rejected because of

the statistical significance of the results ($p = .001$). The regression model indicated a linear relationship between perceived ease of use and intent to use Blackboard Mobile learn. This finding indicated that if students perceive the mobile application to be useful for their course work, they will intend to use it. In conclusion, the answer to the first research question is that there is a linear relationship between students' usage intentions of Blackboard Mobile Learn and their perceived usefulness and perceived ease of use of Blackboard Mobile Learn.

2. For the second research question, the following hypotheses and results are reported below and in chapter 4. The following null hypotheses state that students do not intend to use Blackboard Mobile Learn for these specific functions: Announcements, Information, Contacts, Discussions, and My Grades ($H_0 2$: $\mu \leq +0.5$).

a. $H_0 2$a: Students do not intend to use Blackboard Mobile Learn for Announcements ($\mu \leq +0.5$). This null hypothesis $H_0 2$a was rejected at a 0.05 level of significance ($p < 0.001$).

b. $H_0 2$b: Students do not intend to use Blackboard Mobile Learn for Information, which includes syllabus ($\mu \leq +0.5$). This null hypothesis $H_0 2$b was rejected at a 0.05 level of significance ($p < 0.001$).

c. $H_0 2$c: Students do not intend to use Blackboard Mobile Learn for Contacts, which includes professor e-mail and office hours ($\mu \leq +0.5$). This null hypothesis $H_0 2$c was rejected at a 0.05 level of significance ($p < 0.001$).

d. $H_0$2d: Students do not intend to use Blackboard Mobile Learn for Discussions ($\mu \leq +0.5$). This null hypothesis $H_0$2d was not rejected at a 0.05 level of significance because of the large probability value ($p = 0.431$).

e. H_0*2*e: Students do not intend to use Blackboard Mobile Learn for My Grades ($\mu \leq +0.5$). This null hypothesis H_0*2*e was rejected at a 0.05 level of significance ($p < 0.001$).

Based on these findings, it is likely that students might use Blackboard Mobile Learn for several specific functions: Announcements, Information, Contacts, and My Grades. For example, a student who is enrolled in a course that uses Blackboard Learn might use his or her iPhone to see the course Announcements or check his or her grade using My Grades. Another student might use his or her iPad to check the course syllabus or the professor's office hours. The results for the Discussions function were inconclusive, suggesting that although a student might use his or her Android smartphone to read the class discussion on a recent news report and post his or her response, other students might not use the Discussions function on Blackboard Mobile Learn; they might prefer to use their laptop for this function.

3. The third hypothesis is similar to the second, but it differed in that it was expected that some functions, Assignments and Course Documents, may not be as suited for the mobile environment. The following null hypotheses state that students intend to use Blackboard Mobile Learn for these specific functions: Assignments, and Course Documents ($H_0$3: $\mu \geq -0.5$).

a. $H_0$3a: Students intend to use Blackboard Mobile Learn for Assignments, which include homework, quizzes and exams ($\mu \geq -0.5$). According to the results of this left-tailed *t* test, this null hypothesis $H_0$3a was not rejected at a 0.05 level of significance ($p > 0.999$).

b. $H_0$3b: Students intend to use Blackboard Mobile Learn for Course Documents, which include main course content, lecture notes, or handouts ($\mu \geq -0.5$). According to the results of this left-tailed *t* test, this null hypothesis $H_0$3b was not rejected at a 0.05 level of significance ($p > 0.999$).

Based on these findings of these left tailed tests, nothing can be concluded about the right tails for these functions, Assignments and Documents. Students may view and complete some homework assignments using Blackboard Mobile Learn. For example, a student might use his or her iPad to take a weekly chapter quiz. Also, students might use their mobile devices to access course documents. For instance, a student might review the course lecture notes using his or her iPhone just before taking an in-class test. A caution is added to these findings because of the inclusion of ordinal level variables in the analysis.

Implications for Social Change

This study added to the literature regarding students' perceptions of and intent to use a mobile CMS, Blackboard Mobile Learn, as noted in chapter 1. The findings that supported the first research question might guide the efforts of the director of marketing to inform students of the usefulness and ease of use of this mobile application. The

director may inform students by creating YouTube videos of students using Blackboard Mobile Learn, and posting them on the college Facebook page.

Professors may improve their online Blackboard courses with the knowledge that specific functions may be used by students on their mobile devices. For example, a professor may modify his or her 14-page course handout into several smaller handouts for faster and easier viewing on mobile devices. These findings may be valuable to the college instructional designer who assists faculty with Blackboard course development. These possibilities underscore the significance of this study for improving online course delivery for mobile devices.

College administrators require information to facilitate decision making regarding mobile applications for students and faculty. The conclusions from this study may provide them with useful information that can be used to support such mobile learning initiatives. With the advent of the budget crisis, literature that supports students' intent to use a mobile learning platform is crucial in generating support for such projects. This study may encourage other colleges and universities to support mobile learning technologies. From these findings, students may benefit from using tools such as Blackboard Mobile Learn. The advantages of mobile learning may help some students to succeed in their current courses and may encourage them to continue taking courses. In conclusion, the key positive social change of this study is that it may provide a CMS m-learning solution for students to be lifelong learners: "Never Stop Learning".

Recommendations for Action

The findings of this study will be disseminated to the research participants and community stakeholders via a website for a period of 4 months after dissertation approval: http://www.rmathurweb.com/phd/. I will notify the Swaril College Distance Education Task Force of the availability of the results; the meeting minutes will help to disseminate the link to the study.

College administrators, such as the college district's vice chancellor of Technology and Learning Services, may use these findings to support requests for additional resources towards mobile learning. Due to the dire current budget crisis in California, documentation of the importance of such initiatives is welcomed. The college's director of technology may use the results to provide training for professors to improve their Blackboard course development. He may request the instructional designer to offer faculty training, specifically to improve the course information access for students using mobile devices. The distance education office at either college can also use the results for similar faculty workshops.

Based on the findings of this study, this research has significant implications for not only for both colleges, but also for other community colleges. Although caution should be used in generalizing the results of this study to other community colleges in the United States, these findings may be beneficial for pedagogical practices in a variety of higher education institutions, regardless of size, private or public status, or online versus brick-and-mortar setup.

Recommendations for Further Study

There is a lack of literature regarding student perceptions of mobile CMS, yet this field is ripe with opportunity and potential for growth. Indeed, numerous studies could provide further research in this field of mobile learning. This study was conducted in two community colleges in southern California. A key suggestion for future research is to conduct a similar study across a variety of community colleges and 4-year universities so the results can be generalized to a wider student body. I focused the study on intent to use the mobile application, rather than actual usage, because of the recent release and limited availability of this tool. However, a future study may wish to focus on actual usage of Blackboard Mobile Learn. This future study could incorporate a longitudinal research design to see if students' perceptions and actual usage change over time.

Based on the results to the second research question in this study, I propose conducting a similar study but using right-tailed *t* tests for all of the functions. This may provide conclusive statements regarding whether students intend to use Blackboard Mobile Learn's functions, Assignments and Course Documents. Another research question may be added to future studies regarding the relationship between the demographic factors and their use of Blackboard Mobile Learn. For example, a possible research question could investigate whether age influences the use of mobile learning. Even though, this information was collected for this study, the focus of the research questions was not on the demographic data. In future studies, another question could explore how socio-economic status influences the use of mobile learning.

A future study could use a mixed methods approach, using both quantitative and qualitative methods. The study could include a survey of both closed-ended and open-ended questions and interviews of a group of students to better understand students' perceptions and intentions of a mobile CMS. The mixed methods approach could also be used to study the effectiveness of a mobile CMS or the effectiveness of mobile learning. For example, a future study may use two groups of students, one that is given access to a learning unit on a mobile device, while the other has an identical unit available on a laptop or desktop. A presurvey and postsurvey could be used on both groups to study the effectiveness of mobile learning. An important research aim, then, for future studies is to address the efficacy of mobile learning.

In this study, I asked one question regarding the types of devices used by the students, such as desktops, laptops, iPads or similar tablets, iPod Touch, and smartphones. Future studies could expand on this theme to explore how students use each electronic device. For example, future studies could assess the number of hours per day that students use each device. This finding may reveal that laptops and desktops are used for a much larger amount of time than all of the other devices combined because students primarily complete their homework assignments using their laptops and desktops. Students could be asked how many gaming applications they have downloaded on their smartphones, as well as their use of educational applications. A case study may explore how students and faculty use the newly released iPads or similar tablets for educational purposes.

Summary

This study supported the TAM for Blackboard Mobile Learn at two local community colleges. The findings confirmed the importance of mobile learning. With smartphones and iPads or similar tablets becoming even more ubiquitous, students might use mobile applications for educational purposes to increase their productivity and efficiency. Mobile learning may transform education as distance education did a decade earlier. From the findings of this study, it is recommended that colleges and universities consider the impact of mobile learning and how to best provide mobile learning technologies to their students.

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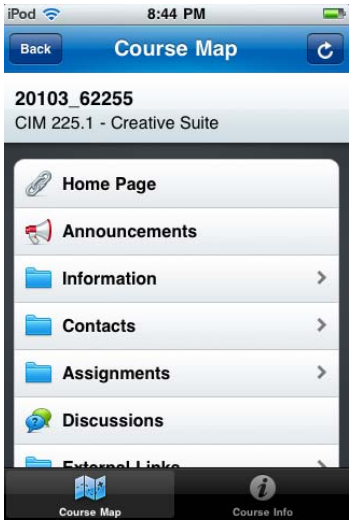
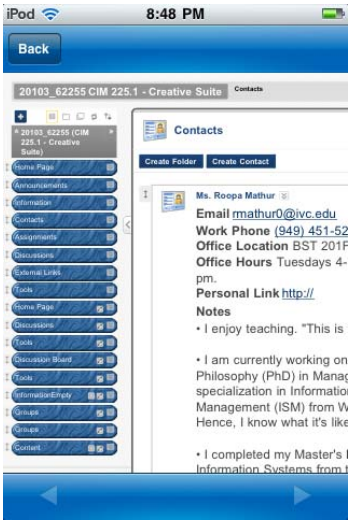
Appendix A: Survey Instrument

Blackboard Mobile Learn is a newly released mobile application ("app") that offers course content on mobile devices, such as the iPad, iPod Touch, iPhone, Android, and Blackberry smartphones; students may access their course Announcements, Information/Syllabus, Course Documents, Contacts, Assignments, Discussions, and My Grades using this mobile application. The following screen shots illustrate Blackboard Mobile Learn's Course Map, Discussions, and Contact information. For an interactive demo of Blackboard Mobile Learn, go to http://blackboard.com/platforms/mobile/products/mobile-learn.aspx.





This is a self-administered web survey for students enrolled in a distance education or hybrid class at either Abhay College or Swaril College. The survey will provide quantitative data on student perceptions, prior experience with online delivery, and demographic information. Only adults, age 18 years old or above, are invited to

complete the survey. The questionnaire will take approximately five minutes to complete. Thank you for your participation.

The Questionnaire

Demographic data

1) What is your gender?
   - □ a) Male
   - □ b) Female
   - □ c) Prefer not to mention
2) What is your age group?
   - □ a) Below 18 years old
   - □ b) 18 to 25 years old
   - □ c) 26 to 35 years old
   - □ d) 36 to 45 years old
   - □ e) 46 to 55 years old
   - □ f) 56 to 65 years old
   - □ g) Above 65 years old
   - □ h) Prefer not to mention
3) Which college are you currently enrolled in?
   - □ a) Abhay College
   - □ b) Swaril College
   - □ c) Both
4) How many years have you been using a computer?

- □ a) Less than 1 year
- □ b) 1 to 3 years
- □ c) 4 to 6 years
- □ d) More than 6 years
- □ e) Prefer not to mention

5) How many years have you been using Blackboard Learn, the Web-based application used on personal computers or laptops?

- □ a) Less than 1 year
- □ b) 1 to 3 years
- □ c) 4 to 6 years
- □ d) More than 6 years
- □ e) Prefer not to mention

6) Select all the types of devices you use (you may select more than one):

- □ a) Desktop personal computer (for example, a PC or an iMac)
- □ b) Laptop
- □ c) Netbook
- □ d) iPad
- □ e) iPhone
- □ f) iPod Touch
- □ g) Android smartphone
- □ h) BlackBerry smartphone
- □ i) other mobile phone/device

□ j) e-book reader

□ k) none of the above

7) On your mobile device, do you use the mobile application Blackboard Mobile Learn?

□ a) Yes

□ b) No

□ c) Do not use any mobile devices

Please continue with the remaining questions irrespective of your answer to the previous question.

Perceptions, Intentions of Blackboard Mobile Learn

For the following questions, imagine that you have access to Blackboard Mobile Learn. These questions ask you to indicate your perceptions whether you would find Blackboard Mobile Learn to be useful and easy to use. In addition, a few questions ask you to indicate your intentions to use this mobile application.

The scale is a 5-point scale: *strongly agree*, *agree*, *neutral* (neither agree nor disagree), *disagree*, or *strongly disagree*.

8) Assuming I had access to Blackboard Mobile Learn, I intend to use it.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

9) My interaction with Blackboard Mobile Learn would be clear and understandable.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

10) Using Blackboard Mobile Learn would improve my performance in my course(s).

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

11) I would find it easy to get Blackboard Mobile Learn to do what I want it to do.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

12) Using Blackboard Mobile Learn in my course(s) would increase my productivity.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

13) I would find Blackboard Mobile Learn to be easy to use.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

14) Given that I had access to Blackboard Mobile Learn, I predict that I would use it.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

15) I would find Blackboard Mobile Learn to be useful in my courses.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

16) Interacting with Blackboard Mobile Learn would not require a lot of my mental effort.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

17) Using Blackboard Mobile Learn would enhance my effectiveness in my course(s).

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

Intention to use Blackboard Mobile Learn

Beside each of the statements presented below, please indicate your intention to use Blackboard Mobile Learn to access each of the following functions.

18) I intend to use Blackboard Mobile Learn to access my course Announcements.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

19) I intend to use Blackboard Mobile Learn to access my course Information, which sometimes includes the course syllabus.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

20) I intend to use Blackboard Mobile Learn to access my course Contacts, which sometimes includes my professor's e-mail and office hours.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

21) I intend to use Blackboard Mobile Learn to access my course Discussions.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

22) I intend to use Blackboard Mobile Learn to access my course My Grades.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

23) I intend to use Blackboard Mobile Learn to access my course Assignments, which sometimes includes homework, quizzes, and exams.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

24) I intend to use Blackboard Mobile Learn to access my course Documents, which sometimes includes the main course content, lecture notes, or handouts.

□ a) Strongly agree

□ b) Agree

□ c) Neutral

□ d) Disagree

□ e) Strongly Disagree

Thank you for completing this survey. Your time devoted to this survey is appreciated.

Appendix B: E-Mail Invitations

E-Mail Invitation for Pilot Study

From: Roopa Mathur [rmathur@abhay.edu]
To: [course section e-mail address]
Subject: Blackboard
Dear Student,

You have been selected to participate in a pilot study about a Blackboard survey. Your participation in this pilot research is very important as it represents the views of many of your classmates. Your responses to the pilot will be used to evaluate the Blackboard survey and possibly make modifications to the actual Blackboard survey.

I am Assistant Professor of Computer Information Management in the School of Business Sciences at Abhay College. I am also a Ph.D. student in Management: Information Systems Management at Walden University. As part of my dissertation research, I am conducting a survey of Blackboard student users within Abhay College and Swaril College. Both colleges are part of the Mathur County Community College District. Permission to conduct this research has been obtained from Dr. Robert [redacted], Vice Chancellor, Technology and Learning Services, Mathur County Community College District.

I kindly request you to participate in this pilot study if you are an adult (age of 18 years old or above) and are a student user of Blackboard. Survey results will be reported in the dissertation or related articles in an aggregate fashion. Your participation is completely voluntary. Your identity will not be linked to your responses in any way; furthermore, you do not need to identify yourself on the questionnaire.

Your participation is very important to the success of this pilot study. The anonymous survey should take about five minutes to complete since it consists mostly of closed-ended questions on a "strongly agree" to "strongly disagree" scale. If you agree to be in this pilot study, you will be asked to complete the web-based survey. Due to course schedules, some students may receive the invitation more than once; however, it is requested you complete the survey just once.

Your completion of the survey will indicate your consent, if you choose to participate. To participate in the pilot survey, please click on the following link:

http://survey.mathur.edu/Survey/TakeSurvey.aspx?SurveyID=n201588

The pilot survey will be available for one week, until Wednesday, March 9, 2011. If you have any questions, comments, or need help, please do not hesitate to contact me. Thank you for your timely response.

Thank you and best regards,
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[redacted]
rmathur@abhay.edu
 Think Green! Consider not printing this e-mail.

E-Mail Invitation for the Actual Study

From: Roopa Mathur [rmathur@abhay.edu]
To: [course section e-mail address]
Subject: Blackboard
Dear Student,

You have been selected to participate in a survey about Blackboard. Your participation in this research is very important as it represents the views of many of your classmates. The data will be used to evaluate the Blackboard applications.

I am Assistant Professor of Computer Information Management in the School of Business Sciences at Abhay College. I am also a Ph.D. student in Management: Information Systems Management at Walden University. As part of my dissertation research, I am conducting a survey of Blackboard student users within Abhay College and Swaril College. Both colleges are part of the Mathur County Community College District. Permission to conduct this research has been obtained from Dr. Robert [redacted], Vice Chancellor, Technology and Learning Services, Mathur County Community College District.

I kindly request you to participate in this study if you are an adult (age of 18 years old or above) and are a student user of Blackboard. Survey results will be reported in the dissertation or related articles in an aggregate fashion. Your participation is completely voluntary. Your identity will not be linked to your responses in any way; furthermore, you do not need to identify yourself on the questionnaire.

Your participation is very important to the success of this study. The anonymous survey should take about five minutes to complete since it consists mostly of closed-ended questions on a "strongly agree" to "strongly disagree" scale. If you agree to be in this study, you will be asked to complete the web-based survey. Due to course schedules, some students may receive the invitation more than once; however, it is requested you complete the survey just once.

Your completion of the survey will indicate your consent, if you choose to participate. To participate in the survey, please click on the following link:

http://survey.mathur.edu/Survey/TakeSurvey.aspx?SurveyID=8402684

The survey will be available for the next two weeks, until Wednesday, March 23, 2011. If you have any questions or need help, please do not hesitate to contact me. Thank you for your timely response.

Thank you and best regards,
Mrs. Mathur
Assistant Professor, Computer Information Management
School of Business Sciences
Abhay College www.abhay.edu
[redacted]
rmathur@abhay.edu
 Think Green! Consider not printing this e-mail.

Follow-up E-Mail Invitation

From: Roopa Mathur [rmathur@abhay.edu]
To: [course section e-mail address]
Subject: Blackboard
Dear Student,

You received an invitation to participate in a survey about Blackboard on March 10, 2011. If you have completed the survey once, thank you very much for your participation. If you have not completed the survey, please take five minutes to complete it now by clicking on the link below. The survey will be available for only three more days, until Wednesday, March 23, 2011 at 8 pm. Thank you for your time.

As stated in the previous e-mail, your participation in this research is very important as it represents the views of many of your classmates. The data will be used to evaluate the Blackboard applications.

I am Assistant Professor of Computer Information Management in the School of Business Sciences at Abhay College. I am also a Ph.D. student in Management: Information Systems Management at Walden University. As part of my dissertation research, I am conducting a survey of Blackboard student users within Abhay College and Swaril College. Both colleges are part of the Mathur County Community College District. Permission to conduct this research has been obtained from Dr. Robert [redacted], Vice Chancellor, Technology and Learning Services, Mathur County Community College District.

I kindly request you to participate in this study if you are an adult (age of 18 years old or above) and are a student user of Blackboard. Survey results will be reported in the dissertation or related articles in an aggregate fashion. Your participation is completely voluntary. Your identity will not be linked to your responses in any way; furthermore, you do not need to identify yourself on the questionnaire.

Your participation is very important to the success of this study. The anonymous survey should take about five minutes to complete since it consists mostly of closed-ended questions on a "strongly agree" to "strongly disagree" scale. If you agree to be in this study, you will be asked to complete the web-based survey. Due to course schedules, some students may receive the invitation more than once; however, it is requested you complete the survey just once.

Your completion of the survey will indicate your consent, if you choose to participate. To participate in the survey, please click on the following link:

http://survey.mathur.edu/Survey/TakeSurvey.aspx?SurveyID=8402684

If you have any questions or need help, please do not hesitate to contact me. Thank you for your timely response.

Thank you and best regards,
Mrs. Mathur
Assistant Professor, Computer Information Management
School of Business Sciences
Abhay College www.abhay.edu
[redacted]
rmathur@abhay.edu
Think Green! Consider not printing this e-mail.

Appendix C: Survey Questionnaire Consent Form

You are invited to take part in a research study of Blackboard. You were chosen for the study because you are currently enrolled in a course at either Abhay College and/or Swaril College which uses Blackboard. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Roopa Mathur, who is a doctoral student at Walden University. Mrs. Mathur is also an Assistant Professor of Computer Information Management in the School of Business Sciences at Abhay College.

Background Information:
The purpose of this quantitative survey study is to explore higher education students' perceptions of and intent to use a mobile application, Blackboard Mobile Learn. Blackboard Mobile Learn is a newly released mobile application ("app") that offers course content on mobile devices, such as the iPad, iPod Touch, iPhone, Android, and Blackberry smartphones; students may access course Announcements, Information/Syllabus, Course Documents, professor Contacts, Assignments, Discussions, and My Grades using this mobile app. Like most mobile applications, Blackboard Mobile Learn requires a network connection; hence, the mobile device needs either a Wi-Fi (Wireless Fidelity) connection or a 3G/4G cellular network connection with a data service plan. The survey will provide quantitative data on demographic information, students' perceptions and students' intent to use Blackboard Mobile Learn.

Procedures:
If you agree to be in this study, you will be asked to complete a web-based survey which will take approximately five minutes. Only adults, age 18 years old or above, are eligible to participate in this study. Due to course schedules, some students may receive the invitation more than once; however, it is requested you complete the survey just once.

Voluntary Nature of the Study:
Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. No one at Abhay College or Swaril College will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind during the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal.

Risks and Benefits of Being in the Study:
There are no known risks of any kind associated with taking this survey. Permission to conduct this research has been obtained from Dr. Robert [redacted], Vice Chancellor, Technology and Learning Services, Mathur County Community College District. Higher education administrators need data on student perceptions to support their decision-making regarding mobile learning applications for Course Management Systems (CMS). This study will provide data which may help to understand student perceptions of usefulness and ease of use as predictors of usage for a mobile CMS application. Your participation in this research is very important as it represents the views of many of your classmates.

Compensation:
You will not receive any compensation for being in the study.

Confidentiality:
Any information you provide will be kept anonymous. Your participation will be completely anonymous. Therefore, your identity will not be disclosed to anyone at anytime. Your identity will not be linked to your responses in any way; furthermore, you do not need to identify yourself on the questionnaire. Survey results will be reported in the dissertation or related articles in an aggregate fashion. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study. The raw data will be exported from the survey tool SelectSurvey.NET and transferred to two of the researcher's USB (Universal Serial Bus) flash drives for safe-keeping and backup. The backup copy will be kept at a different location. For data disposal, the USB drives with the data will be securely erased (all files deleted) after a period of five years.

Contacts and Questions:
You may ask any questions you have now. Or if you have questions later, you may contact the researcher via Mrs. Mathur's phone number: [redacted] or e-mail address: rmathur@abhay.edu. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is **03-02-11-0125170** and it expires on **March 1, 2012.**

Please print a copy of this consent form if you wish to keep it.

Statement of Consent:
I have read the above information and I feel I understand the study well enough to make a decision about my involvement. I am agreeing to the terms described above. To protect your privacy, no signature will be required on this consent form. Completion of the following survey indicates your consent to participate.

Appendix D: Actual Survey Data

id	gender	agegroup	college	pcuseryrs	bbluseryrs	dvc (Desktop personal computer)
1	1	3	2	4	2	1
2	2	2	2	4	2	0
3	2	3	1	4	1	1
4	2	3	2	4	2	1
5	2	5	1	4	3	0
6	2	2	2	4	2	1
7	2	2	3	3	1	0
8	1	2	2	4	2	1
9	2	3	2	4	2	1
10	2	4	1	4	2	1
11	2	3	2	4	2	0
12	2	2	2	4	3	0
13	2	3	2	4	2	0
14	1	2	1	4	2	1
15	2	4	2	4	2	0
16	1	2	1	4	1	0
17	2	4	1	3	1	0
18	1	2	3	3	2	0
19	1	4	1	5	1	1
20	1	3	2	4	3	0
21	2	2	1	3	4	1
22	2	4	2	4	1	1
23	2	4	2	4	1	1
24	2	3	2	4	3	1
25	2	2	2	4	3	1
26	1	2	1	4	2	1
27	1	2	2	4	3	1
28	2	2	1	3	3	1
29	1	2	2	4	2	1
30	2	2	3	4	1	1
31	1	2	2	4	3	1
32	1	4	3	4	2	1
33	1	2	3	4	2	1
34	2	8	1	4	1	1

id	gender	agegroup	college	pcuseryrs	bbluseryrs	dvc (Desktop personal computer)
35	2	1	1	4	1	0
36	1	2	3	4	2	1
37	1	2	2	4	1	1
38	1	2	2	4	2	1
39	2	2	2	4	1	1
40	1	2	2	4	1	0
41	1	2	3	4	2	0
42	1	2	1	4	1	1
43	1	5	2	4	2	1
44	2	2	3	2	2	1
45	2	2	2	4	1	1
46	2	2	3	4	2	1
47	1	3	2	2	2	1
48	2	6	1	4	3	1
49	2	2	3	3	1	1
50	2	2	1	4	2	0
51	2	6	2	4	2	1
52	2	2	1	4	2	1
53	2	2	2	4	3	1
54	2	3	2	4	1	1
55	2	2	1	4	2	1
56	2	3	2	4	1	0
57	2	3	2	4	2	0
58	2	2	3	2	2	1
59	1	3	3	4	3	1
60	2	2	2	3	2	0
61	2	3	2	4	1	1
62	1	2	3	4	2	0
63	2	2	2	4	2	0
64	2	2	2	4	3	0
65	2	2	1	4	2	1
66	1	2	2	4	2	1
67	2	2	2	4	2	1

id	gender	agegroup	college	pcuseryrs	bbluseryrs	dvc (Desktop personal computer)
68	1	4	1	4	1	1
69	1	2	1	4	2	1
70	2	5	1	4	3	1
71	1	2	2	4	2	1
72	1	2	2	4	1	1
73	1	2	2	4	2	1
74	2	2	1	4	2	1
75	1	3	1	4	4	1
76	2	2	2	4	2	0
77	2	3	2	4	2	1
78	1	2	1	4	1	0
79	2	2	2	4	1	1
80	2	2	2	4	3	1
81	2	2	1	3	2	1
82	2	2	1	4	2	0
83	1	2	2	4	1	1
84	1	1	1	3	1	1
85	3	8	1	3	1	1
86	1	6	2	4	1	1
87	3	2	3	3	1	1
88	1	2	1	4	2	1
89	1	1	1	2	1	1
90	2	2	2	4	2	1
91	2	3	1	4	1	1
92	2	2	2	4	1	0
93	2	2	2	4	1	0
94	2	3	2	4	2	0
95	2	3	2	4	2	0
96	1	3	2	4	2	0
97	2	3	2	4	2	0
98	1	5	1	4	3	1

id	dvc (Laptop)	dvc (Netbook)	dvc (iPad)	dvc (iPhone)	dvc (iPod Touch)	dvc (Android smartphone)	dvc (BlackBerry smartphone)
1	1	0	1	1	1	0	0
2	1	0	0	0	0	0	0
3	1	0	0	0	0	0	1
4	1	0	0	0	0	0	0
5	1	0	0	0	0	0	1
6	1	1	1	0	1	1	0
7	1	0	0	1	0	0	0
8	0	0	0	0	0	0	0
9	1	0	0	0	0	0	0
10	0	0	0	0	0	0	1
11	1	0	0	0	0	0	0
12	1	0	0	0	0	0	0
13	1	0	0	0	0	0	0
14	1	0	0	0	0	0	0
15	1	0	0	0	0	0	0
16	1	0	0	0	0	0	0
17	1	0	0	0	0	0	0
18	1	0	0	1	1	0	0
19	1	0	0	0	0	0	0
20	1	0	0	0	0	1	0
21	1	0	0	0	0	0	0
22	1	0	0	0	0	0	0
23	1	1	0	0	0	0	0
24	1	0	0	0	0	0	0
25	1	0	0	0	0	1	0
26	1	1	0	0	0	1	1
27	0	0	0	0	0	0	0
28	1	0	0	0	0	1	0
29	0	0	0	0	0	0	0
30	1	0	0	0	0	0	0
31	1	0	0	0	1	0	0
32	1	0	0	0	1	1	0
33	1	1	0	0	0	0	0
34	0	0	0	0	1	1	0

id	dvc (Laptop)	dvc (Netbook)	dvc (iPad)	dvc (iPhone)	dvc (iPod Touch)	dvc (Android smartphone)	dvc (BlackBerry smartphone)
35	1	0	0	0	0	0	0
36	1	0	0	0	0	0	1
37	0	0	0	0	0	0	0
38	1	0	0	0	0	0	0
39	1	0	0	1	1	0	0
40	1	0	0	0	1	0	0
41	1	0	0	1	0	0	0
42	0	0	0	0	0	1	0
43	1	0	0	0	0	0	0
44	1	0	0	0	0	1	1
45	1	0	0	1	1	0	0
46	1	0	0	0	0	1	0
47	0	0	0	0	0	0	0
48	1	0	1	1	0	0	0
49	1	0	0	0	0	0	0
50	1	0	0	0	0	0	0
51	1	0	0	0	0	0	0
52	1	0	0	1	0	0	0
53	1	0	0	0	0	0	0
54	1	0	0	0	0	0	1
55	0	0	0	0	1	0	0
56	1	0	1	0	0	1	0
57	1	0	0	1	0	0	0
58	1	0	0	1	1	1	1
59	1	1	0	1	0	1	0
60	1	0	0	1	1	0	0
61	0	0	0	0	0	0	0
62	1	0	1	0	1	0	1
63	1	0	0	1	0	0	0
64	1	0	1	1	0	0	0
65	1	0	0	1	0	0	0
66	1	0	0	0	1	0	1
67	1	0	0	0	0	0	0

id	dvc (Laptop)	dvc (Netbook)	dvc (iPad)	dvc (iPhone)	dvc (iPod Touch)	dvc (Android smartphone)	dvc (BlackBerry smartphone)
68	1	0	0	1	0	0	0
69	1	0	0	0	1	1	0
70	1	1	0	0	0	1	1
71	1	1	0	0	0	1	0
72	0	0	0	1	0	0	0
73	1	0	0	1	0	0	0
74	0	0	0	0	0	0	0
75	1	0	0	1	0	0	0
76	1	0	0	0	0	0	0
77	1	0	1	1	0	0	0
78	1	0	0	0	0	1	0
79	1	0	1	0	0	0	0
80	0	0	1	0	0	0	0
81	0	0	0	0	0	0	0
82	1	0	0	0	1	0	0
83	1	0	0	0	0	1	0
84	0	0	0	0	0	0	0
85	0	0	0	0	0	0	0
86	1	0	0	0	0	0	1
87	1	0	0	0	1	1	0
88	0	0	0	0	0	0	0
89	1	0	0	0	0	0	0
90	1	0	1	1	1	0	0
91	1	0	0	0	0	0	0
92	1	0	0	0	0	0	0
93	1	0	0	1	1	0	0
94	1	0	1	1	0	0	0
95	1	0	1	1	0	0	0
96	1	0	0	1	0	0	0
97	1	0	0	1	0	0	0
98	1	0	0	0	0	0	0

id	dvc (other mobile phone/device)	dvc (e-book reader)	dvc (none of the above)	bbml_iuseit	bbml_intnduse
1	0	1	0	2	2
2	0	0	0	2	1
3	0	0	0	2	1
4	1	0	0	2	0
5	0	0	0	2	1
6	0	0	0	2	
7	0	0	0	1	1
8	0	0	0	3	0
9	0	0	0	2	2
10	0	0	0	1	2
11	0	0	0	2	1
12	0	0	0	1	2
13	0	0	0	3	1
14	0	0	0	2	2
15	0	0	0	2	1
16	1	0	0	2	2
17	0	0	0	3	1
18	0	0	0	2	1
19	1	0	0	2	1
20	0	0	0	2	0
21	0	0	0	3	0
22	0	0	0	2	0
23	1	0	0	2	1
24	0	0	0	2	2
25	0	0	0	2	1
26	0	0	0	1	2
27	1	0	0	2	1
28	0	0	0	2	0
29	0	0	0	3	2
30	0	0	0	3	1
31	0	0	0	2	2
32	0	0	0	1	2
33	1	0	0	2	2
34	0	0	0	2	1

id	dvc (other mobile phone/device)	dvc (e-book reader)	dvc (none of the above)	bbml_iuseit	bbml_intnduse
35	0	0	0	2	
36	0	0	0	1	1
37	0	0	0	2	1
38	0	0	0	1	2
39	0	0	0	2	2
40	0	0	0	1	2
41	0	0	0	2	1
42	0	0	0	2	2
43	1	0	0	2	0
44	0	0	0	1	2
45	0	0	0	2	1
46	0	0	0	1	2
47	0	0	0	3	2
48	0	0	0	2	1
49	1	0	0	2	0
50	0	0	0	2	2
51	1	1	0	2	-2
52	0	0	0	2	2
53	1	0	0	2	1
54	0	0	0	1	1
55	1	1	0	2	-2
56	0	0	0	2	2
57	0	0	0	2	2
58	0	0	0	2	
59	0	0	0	1	0
60	0	0	0	2	0
61	1	0	0	2	1
62	0	0	0	2	0
63	0	0	0	1	1
64	0	0	0	2	2
65	0	0	0	1	2
66	0	0	0	2	2
67	0	0	0	3	1

id	dvc (other mobile phone/device)	dvc (e-book reader)	dvc (none of the above)	bbml_iuseit	bbml_intnduse
68	0	0	0	1	2
69	0	0	0	2	2
70	0	0	0	1	2
71	0	0	0	2	2
72	0	0	0	2	1
73	0	0	0	2	0
74	0	0	0	2	1
75	1	1	0	2	2
76	0	0	0	2	-1
77	0	0	0	1	1
78	0	0	0	2	2
79	0	0	0	2	0
80	0	0	0	1	2
81	0	0	0	2	1
82	0	0	0	1	1
83	0	0	0	2	-2
84	0	0	0	3	1
85	0	0	0	3	1
86	0	0	0	1	2
87	0	0	0	2	-1
88	0	0	0	3	1
89	0	1	0	2	1
90	1	0	0	2	-1
91	0	0	0	2	1
92	0	0	0	3	0
93	0	0	0	2	2
94	0	0	0	2	
95	0	0	0	2	2
96	0	0	0	2	2
97	0	0	0	1	1
98	0	0	0	2	2

id	bbml_clrundr	bbml_perfrmce	bbml_2dowhtiwnt	bbml_prdctvty
1	0	2	0	2
2	0	-2	0	-1
3	0	-1	0	0
4	0	-1	0	-1
5	0	1	0	1
6				
7	1	0	1	1
8	-1	0	-1	0
9	2	1	2	1
10	1	0	1	0
11	1	0	0	1
12	2	2	2	2
13	1	0	0	0
14	0	0	2	2
15	1	1	1	1
16	1	2	2	1
17	1	1	1	1
18	1	0	0	-1
19	1	0	1	1
20	1	0	0	0
21	0	0	0	0
22	-1	-1	-1	-1
23	1	-1	0	-1
24	1	0	1	1
25	1	-1	0	0
26	2	2	2	2
27	1	1	1	1
28	1	0	1	0
29	2	2	2	1
30	1	1	2	-1
31	2	0	2	1
32	2	2	1	2
33	1	1	1	2
34	0	0	0	0

id	bbml_clrundr	bbml_perfrmce	bbml_2dowhtiwnt	bbml_prdctvty
35				
36	1	1	1	1
37	0	0	0	0
38	2	2	2	2
39	1	0	2	2
40	2	2	2	2
41	1	0	0	0
42	2	2	2	2
43	1	0	1	0
44	2	2	2	2
45	1	0	1	0
46	2	2	1	2
47	2	-1	1	1
48	0	0	0	0
49	-1	-2	0	-2
50	1	0	1	0
51	0	-1	-1	-1
52	1	0	1	0
53	1	1	0	0
54	1	1	1	1
55	0	0	-2	1
56	0	1	1	0
57	0	2	0	2
58				
59	0	1	1	1
60	1	1	1	-1
61	1	0	1	0
62	0	1	0	0
63	1	1	1	1
64	1	-1	1	-1
65	2	2	2	1
66	2	2	2	2
67	1	0	1	0

id	bbml_clrundr	bbml_perfrmce	bbml_2dowhtiwnt	bbml_prdctvty
68	2	1	1	2
69	1	1	1	1
70	0	0	-1	0
71	0	1	-2	-1
72	0	1	0	1
73	-1	0	-1	0
74	1	0	0	0
75	2	2	0	1
76	1	-1	0	-2
77	2	1	2	1
78	2	2	2	2
79	0	-1	0	-1
80	1	2	1	2
81	2	0	1	1
82	1	0	0	1
83	0	-1	-2	-2
84	1	0	0	1
85	0	1	0	0
86	2	1	2	1
87	-1	-2	-2	-2
88	0	0	0	0
89	0	1	0	1
90	0	-1	0	-1
91	1	0	0	0
92	1	1	-1	1
93	2	0	2	1
94				
95	2	0	1	1
96	0	-2	0	-2
97	1	2	2	2
98	2	2	2	2

id	bbml_esy2use	bbml_prdctuse	bbml_useful	bbml_mntleffrt	bbml_effectvns
1	0	2	2	0	2
2	0	1	1	0	-1
3	1	1	1	1	0
4	1	-1	0	-1	-1
5	0	1	1	0	1
6					
7	1	1	1	2	0
8	-1	1	1	-1	0
9	1	2	1	2	1
10	2	2	1	2	0
11	1	1	1	2	2
12	2	2	2	2	2
13	1	2	1	2	0
14	2	2	0	2	0
15	1	1	1	1	1
16	1	2	2	2	1
17	1	1	1	1	1
18	-1	0	1	1	0
19	1	1	1	1	0
20	1	-1	0	1	0
21	0	1	1	0	0
22	0	-1	-1	-2	-1
23	0	1	-1	-1	-1
24	1	2	2	2	1
25	0	-1	0	0	0
26	2	2	2	1	1
27	1	1	1	1	1
28	0	1	1	0	0
29	2	2	1	2	1
30	2	2	1	1	-1
31	2	2	2	2	1
32	1	2	2	2	2
33	1	2	1	0	1
34	0	1	1	0	1

id	bbml_esy2use	bbml_prdctuse	bbml_useful	bbml_mntleffrt	bbml_effectvns
35					
36	1	1	1	1	1
37	0	0	0	0	0
38	2	2	2	2	2
39	2	2	1	1	1
40	2	2	2	2	2
41	1	1	0	1	0
42	2	2	2	2	2
43	1	0	0	1	0
44	2	2	2	2	2
45	1	1	1	1	0
46	2	2	2	0	2
47	1	2	1	1	-1
48	-1	1	0	-1	-1
49	0	0	0	-1	-2
50	2	2	2	-1	1
51	0	-2	-1	1	-2
52	1	2	0	0	0
53	0	1	1	0	0
54	1	1	1	1	1
55	-1	-1	1	1	0
56	0	1	1	-1	0
57	0	2	2	0	1
58					
59	1	0	1	1	1
60	1	1	1	1	0
61	1	1	1	1	0
62	0	-1	0	0	0
63	1	1	1	1	1
64	1	1	0	2	0
65	1	1	1	2	1
66	2	2	2	2	2
67	0	0	0	-1	0

id	bbml_esy2use	bbml_prdctuse	bbml_useful	bbml_mntleffrt	bbml_effectvns
68	2	1	1	1	1
69	0	2	1	1	1
70	1	2	0	0	0
71	-1	1	1	1	0
72	1	1	1	1	1
73	0	0	0	0	0
74	0	1	0	1	0
75	0	1	1	0	1
76	0	-2	-1	1	-1
77	2	1	1	2	1
78	2	2	2	2	2
79	0	1	0	1	-1
80	2	2	2	0	1
81	0	0	1	0	1
82	1	1	1	1	0
83	-2	-2	-2	-2	-2
84	1	1	1	0	0
85	-1	1	1	1	1
86	-1	2	1	0	2
87	-2	-2	-2	2	-1
88	0	0	0	0	0
89	1	1	1	0	1
90	0	-1	-1	0	0
91	0	1	0	1	0
92	0	1	0	0	0
93	2	2	1	2	1
94					
95	2	2	2	2	2
96	0	2	0	0	-2
97	2	2	2	2	2
98	2	1	1	-2	1

id	bbml_use_annc	bbml_use_info	bbml_use_cntct	bbml_use_dscus
1	2	2	2	2
2	1	1	1	-1
3	1	1	1	1
4	1	-1	-1	1
5	1	1	1	0
6				
7				
8	0	0	0	0
9	2	1	2	0
10	2	1	-2	1
11	1	1	2	2
12	2	2	1	2
13	2	2	2	0
14	1	1	0	0
15	1	1	1	1
16	1	2	2	2
17	1	1	1	1
18	1	1	1	1
19	1	0	1	2
20	1	-1	1	1
21	1	1	1	0
22	-2	-2	-2	-2
23	2	2	2	-1
24	2	2	2	-2
25	2	-1	1	-1
26	2	2	2	2
27	1	1	1	1
28	1	1	0	0
29	2	2	0	0
30	1	2	1	1
31	2	2	2	2
32	1	1	1	2
33	1	2	2	1
34				

id	bbml_use_annc	bbml_use_info	bbml_use_cntct	bbml_use_dscus
35				
36	1	1	1	1
37	0	0	0	0
38	2	2	2	2
39	1	2	2	0
40	2	2	2	2
41	0	0	-1	0
42				
43	1	1	1	-1
44	2	2	2	2
45	2	2	0	0
46	2	2	2	2
47	1	-1	-2	-2
48	-1	-1	-1	-1
49	2	2	2	0
50	2	2	2	1
51	-1	-1	-1	-1
52	1	1	1	0
53	2	2	1	-1
54	1	1	0	1
55	2	0	2	-1
56	1	1	0	1
57	2	2	2	2
58				
59	2	2	2	2
60	2	1	1	0
61	1	-1	1	-1
62	1	1	2	1
63	1	1	1	1
64	-2	1	-2	-2
65	1	2	1	1
66	2	2	2	2
67	1	1	1	1

id	bbml_use_annc	bbml_use_info	bbml_use_cntct	bbml_use_dscus
68	2	2	2	2
69	1	1	1	1
70	2	2	0	-1
71	-1	2	1	-1
72				
73	0	0	0	1
74	0	0	0	0
75	2	0	1	2
76	-1	-1	-1	-1
77	2	-1	2	1
78	2	2	2	2
79	1	1	1	0
80	2	2	2	2
81	0	0	2	1
82	1	1	1	0
83	-2	-2	-2	-2
84	1	1	1	0
85	1	1	1	0
86	2	2	2	2
87	-1	0	-1	-2
88	0	1	1	1
89	1	1	1	0
90	1	0	0	-1
91	1	0	1	1
92	2	2	2	2
93	1	2	2	1
94				
95	2	2	2	0
96	1	-1	0	0
97	2	2	2	2
98	2	2	2	2

id	bbml_use_grdes	bbml_use_assgn	bbml_use_dcmt
1	2	2	2
2	1	1	-1
3	2	2	2
4	1	-1	-1
5	1	1	1
6			
7			
8	0	0	0
9	2	1	0
10	2	2	1
11	2	2	1
12	2	2	2
13	2	1	2
14	1	1	1
15	1	1	1
16	2	1	2
17	1	1	1
18	2	1	1
19	2	2	0
20	1	1	0
21	1	1	1
22	-2	-2	-2
23	2	1	-1
24	2	1	1
25	2	-1	-1
26	2	1	2
27	1	1	1
28	2	1	1
29	2	2	2
30	1	1	1
31	2	2	2
32	1	2	2
33	2	2	2
34			

id	bbml_use_grdes	bbml_use_assgn	bbml_use_dcmt
35			
36	1	1	1
37	0	0	0
38	2	2	2
39	1	2	2
40	2	2	2
41	0	2	2
42			
43	1	1	1
44	2	2	2
45	2	1	1
46	2	-2	0
47	2	2	2
48	-1	-1	-1
49	2	2	1
50	2	2	2
51	-1	-2	-2
52	2	2	2
53	2	1	1
54	1	1	1
55	1	-1	0
56	1	1	1
57	2	2	2
58			
59	2	2	2
60	1	0	0
61	2	1	-1
62	1	2	1
63	1	1	1
64	2	0	2
65	2	2	2
66	2	2	2
67	1	1	1

id	bbml_use_grdes	bbml_use_assgn	bbml_use_dcmt
68	2	2	2
69	1	1	1
70	2	-1	2
71	-1	1	1
72			
73	1	1	1
74	1	1	1
75	0	2	1
76	-1	-1	-1
77	1	-1	1
78	2	1	2
79	1	1	0
80	2	1	1
81	2	2	2
82	1	1	1
83	-2	-2	-2
84	1	1	0
85	1	1	1
86	2	2	2
87	0	-1	-1
88	1	1	1
89	1	1	1
90	1	-1	-1
91	0	1	1
92	2	2	2
93	2	2	1
94			
95	2	2	1
96	2	-1	-1
97	2	2	2
98	2	2	2

Curriculum Vitae

Roopa Mathur, M.S.

Education:

Ph.D. in Management, Information Systems Management Expected 2011
Walden University, Minneapolis, Minnesota
Dissertation Topic: "Students' Perceptions of a Mobile Application for College Course Management Systems"

M.S. in Computer Information Systems 2004
University of Phoenix, Phoenix, Arizona

B.S. in Electrical Engineering 1985
University of Houston, Texas

Teaching Experience:
Assistant Professor 2005-Present
Computer Information Management (CIM), School of Business Sciences
Abhay College, [redacted], CA
Taught 16 CIM courses using the PC and/or Mac in different modalities, including face-to-face, hybrid and 100% online courses. Topics include PC Hardware/Software, Networking, Microsoft Office, Adobe Creative Suite, and Web Design. Developed numerous new course curriculums and programs. Member of the Courses/Curriculum Committee and the Marketing/Outreach Committee.
Associate Faculty 1997-2005
Swaril College, [redacted], CA
Taught courses in Microsoft Visual Basic and XML (Extensible Markup Language).

Other Experience:
Avionics Systems Engineer 1986-1991
Boeing (formerly McDonnell Douglas)
Long Beach, CA
C-17 Avionics Department

Professional Presentations:

"Educating Instructors on 21st Century Business and Instructional Tools: Mobile Apps in Action," BESAC 2011
"Build Your First Website using Dreamweaver," TechEd 2010
"Bridge your Creativity Using Adobe Bridge Creative Suite 4," TechEd 2009
"Computer Security: How to Protect Your Computer," TechEd 2006

Research Grants:

Statewide Discipline/Industry Collaborative for Business/CIS Education
10/8/2010 – 5/6/2011
"Educating Instructors on 21st Century Business and Instructional Tools: Mobile Apps in Action"
Role: Project Director

New Media & Entertainment Initiative
7/01/2010-6/30/2011
[redacted] County New Media Center (North [redacted] County Community College District)
Role: Co-Project Director for Abhay College

Research Interests:

Mobile Learning
Online Learning
Computer Applications
Information Systems
Critical Thinking
Computer Security

Community Service:
American Heart Association, [redacted], CA 2000-2010
American Cancer Society, [redacted], CA 2008-2010

"Never Stop Learning"