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Testing the Technology Acceptance Model 3 (TAM 3) with the Inclusion of Change Fatigue and Overload, in the Context of Faculty from Seventh-day Adventist Universities : A Revised Model

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ABSTRACT

TESTING THE TECHNOLOGY ACCEPTANCE MODEL 3 (TAM 3) WITH THE
INCLUSION OF CHANGE FATIGUE AND OVERLOAD, IN THE CONTEXT
OF FACULTY FROM SEVENTH-DAY ADVENTIST UNIVERSITIES:
A REVISED MODEL

by

David Andrew Jeffrey

Chair: James Jeffery

ABSTRACT OF GRADUATE STUDENT RESEARCH

Dissertation

Andrews University

School of Education

Title: TESTING THE TECHNOLOGY ACCEPTANCE MODEL (TAM 3) WITH THE INCLUSION OF CHANGE FATIGUE AND OVERLOAD, IN THE CONTEXT OF FACULTY FROM SEVENTH-DAY ADVENTIST UNIVERSITIES: A REVISED MODEL

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Date completed: October 2015

Problem

In recent years, the use of technology in institutions of higher learning has grown significantly. The use of Learning Management Systems (LMSs) is central to this growth. LMSs assist in the ease, consistency, and effectiveness of delivering instruction to students. The challenges involved in implementing an LMS, and the time pressures placed on faculty make decisions concerning LMSs particularly crucial. Since the goal of administration is to encourage adoption and optimal usage of the LMS by as many faculty members as possible, the focus of this study is the dynamic of factors that predict usage of Learning Management Systems.

Method

Two hundred randomly selected faculty members responded to a 40-item SurveyMonkey questionnaire based on the TAM 3 variables plus Change Fatigue, Overload, and demographics. This questionnaire evaluated factors that influence their use of the LMS employed by their university. Correlations, regressions, and path analysis were employed to test critical links between key variables in the model.

Results

Analysis found substantial differences from links in the TAM 3 model. Specifically, factors including Subjective Norm, Image, Computer Self-Efficacy, Computer Anxiety, Computer Playfulness, Perceived Enjoyment, Objective Usability, and Experience did not significantly impact the present model. The consistent dynamic on all of these variables is that with greater fluency, more extensive use of computers, and the effect of digital wisdom, each of these factors fades in importance.

Whereas Overload did not impact the model, Change Fatigue was a significant predictor of lower LMS usage. A more parsimonious revised model of factors that reflect these changes was constructed.

Conclusions

The proposed design appears to be a simpler and more streamlined model for use by administrators in understanding the factors that lead to effective and increased use of Learning Management Systems. The core elements of the TAM 3 remain intact. This suggests that administrators should pay close attention to perceived usefulness of the LMS, perceived ease of use, voluntariness, and change fatigue in selecting and implementing any new system and in seeking to increase adoption of the current system.

Andrews University

School of Education

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A Dissertation

Presented in Partial Fulfillment

of the Requirements for the Degree

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LIST OF ABBREVIATIONS

LMS	Learning Management System
LMSs	Learning Management Systems
TAM	Technology Acceptance Model
AU	Andrews University
Burman	Burman University
LLU	Loma Linda University
LSU	La Sierra University
PUC	Pacific Union College
UC	Union College
SAU	Southern Adventist University
SWAU	Southwestern Adventist University
WAU	Washington Adventist University

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CHAPTER 1

INTRODUCTION

With the advent of the personal computer, higher education has been transformed

by the use of technology. Personal computers are now available and accessible to

individuals, making their use in education possible. The software programs known as

Learning Management Systems (LMSs) have arisen in response to the need to organize

and administer instruction with internet-hosted learning materials (Chapman, 2005).

LMSs are typically web-based, so as to allow anytime, anywhere, access to learning

materials and learning experiences either at the same time as other students

(synchronous) or in a time-flexible format (asynchronous) (Black, Beck, Dawson, Jinks,

& DiPietro, 2007). Different systems have arisen to meet the need, including *Angel,*

Blackboard, Canvas, Desire2Learn, Moodle, OpenClass, and *WebCT*.

LMS providers compete with one another for the lucrative market that exists in

higher education in North America and around the world. Their services enable

instructors to create educational content, to communicate with students, to keep updated

grades available, to allow students to drop assignments into individual folders, to allow

students to complete quizzes and tests online, to facilitate class chats, and to enable other

tasks that can replace or supplement the classroom experience.

The LMS industry, like most technology-based industries, is in a continual state

of transition and has been for as long as it has existed (Beatty & Ulasewicz, 2006). They

are continually updating their software platforms, incorporating new tools and better ways of working, in order to better meet the needs of client institutions and their students. As a result, universities must constantly update and upgrade their software to provide faculty and students with the most current and useful experiences. After considering a number of factors, universities may make the decision to end a relationship with one LMS provider and enter a new relationship with a different provider.

Some of these reasons include a desire for improved value, a choice for improved features, a requirement of compatibility with existing or new university systems, and the desire to align with other universities using a similar system. Whether an LMS is current, is new, or whether a university is going through the process of changing its LMS, faculty members who use the system determine the degree of adoption they pursue. They may respond with enthusiasm, embracing the system and integrating it into their practice. They may respond with indifference, doing the organizationally required minimum when it comes to technology integration. They may even respond by refusing to learn the system and regressing to a technology-absent pedagogical experience. (A. Schmidt, personal communication, January 26, 2012). Talke and Heidenreich (2014) suggest that individuals have a predisposition to resist change rather than naturally accepting it, supporting the likelihood of such a regression. This response is more likely when faculty have been through so many changes as to produce change fatigue, "a sense of malaise, frustration, and cynicism that any change effort was destined to fail" (Ace & Parker, 2010, p. 21).

A number of factors, expressed through the constructs of the TAM 3 (Technology Acceptance Model 3), can help us to understand the Behavioral Intention and resulting

Use Behavior (Venkatesh & Bala, 2008) of faculty members. The TAM 3 focuses on the determinants that influence Perceived Usefulness and Perceived Ease of Use of an innovation. This model is used with two additional proposed constructs as the foundation of this dissertation.

The transition to a new LMS is complicated by the fact that this type of change involves a complex implementation (Black, et al., 2007). There are several factors that influence implementation of an innovation, and the simpler that innovation is, the easier it is to implement. LMSs are very complex and "getting LMSs to work efficiently can be time-consuming, frustrating, and expensive" (Black, et al., 2007). Further complicating the situation is the fact that the end users, university professors, are ultimately responsible for implementation. The teaching faculty have the final say when it comes to implementation, as it is their choices that govern the extent and effectiveness of the use of the new technology (Bothma & Cant, 2011).

LMSs can be expensive enterprises, both in terms of money, and in terms of the time and effort expended to make them work well. They also can positively or negatively impact the quality of education. Seventh-day Adventist universities are called to be effective stewards of their resources and to deliver excellence in all things. These principles apply even to decisions made regarding information technologies and their implementation.

Statement of the Problem

Society depends on education to prepare the leaders and workers who will form society in the present and the future. This makes education of critical importance. Learning Management Systems, educational tools, are both expensive to purchase and

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time-consuming to install and implement. Special care should therefore be taken in the decisions related to selecting LMSs. The complexities involved in the nature of the technology, the challenges involved in implementing an LMS, and the time pressures placed on faculty make decisions concerning LMSs particularly significant. It is therefore important for Adventist university administrators who select LMSs and administer the implementation process to understand the factors that lead to successful implementation and high use behavior among the faculty of Seventh-day Adventist universities in North America.

Purpose of the Study

The purpose of this study is to measure the impact of the factors in the TAM 3 model and new factors of Overload and Change Fatigue on the intention and usage of LMSs by North American Adventist university faculty.

Research Questions

The research questions that guide this study are as follows:

What factors influence the use behavior of faculty members among nine Adventist institutions of higher learning in North America?

How do faculty members among nine Adventist institutions of higher education in North America who use LMSs respond to change fatigue with respect to the Learning Management System platforms with which they teach?

How do faculty members among nine Adventist institutions of higher education in North America who use LMSs respond when under conditions of overload?

Is there evidence that the dynamic of factors that influence the usage of LMSs in nine Adventist institutions of higher learning has shifted since the publication of the TAM 3 model in 2008, requiring a new model to explain use behavior?

Definition of Terms

Web-enhanced learning: Online course activity complements class sessions without reducing the number of required class meetings (Coswatte, 2014)

Computer support: the technical and problem-solving support provided to end-users by institutional computer professionals

Learning Management System: a Web-based software solution to simplify the administration of learning programs. It tracks learner progress through a learning program, provides a forum for collaboration, centralizes program information and scheduling, provides a forum for synchronous and asynchronous courseware, and enables the assessment of learning effectiveness (Sun Microsystems, Inc.(Chapman, 2005))

User-friendliness: perceived ease of use of the information system (Baturay & Bay, 2010)

Behavioral Intention: The degree to which a person has formulated conscious plans to perform or not perform some specified future behavior.

Computer Anxiety: The degree of an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers.

Computer Playfulness: The degree of cognitive spontaneity in microcomputer interactions.

Computer Self-Efficacy: The degree to which an individual believes that he or she has the ability to perform specific tasks/jobs using computers.

Image: The degree to which use of an innovation is perceived to enhance one's status in one's social system.

Job Relevance: Individual's perception regarding the degree to which the target system is relevant to his or her job.

Objective Usability: A comparison of systems based on the actual level (rather than perceptions) of effort required to complete specific tasks.

Output Quality: The degree to which an individual believes that the system performs his or her job tasks well.

Perceived Ease of Use: The degree of ease associated with the use of the system.

Perceived Usefulness: The degree to which the system enhances job effectiveness.

Perceptions of External Control: The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.

Result Demonstrability: Tangibility of the results of using the innovation.

Subjective Norm: Person's perception that most people who are important to him think he should or should not perform the behavior in question.

Voluntariness: The extent to which potential adopters perceive the adoption decision to be non-mandatory (Venkatesh & Bala, 2008).

Change Fatigue: "A sense of malaise, frustration, and cynicism that any change effort was destined to fail" (Ace & Parker, 2010, p. 21).

Change Overload: The experience of individuals in a situation where they have to deal with more changes than they are personally comfortable with.

Use Behavior: The daily usage of the adopted technology. It includes frequency, duration, and intensity of use (Van Raaij & Verhallen, 1983). A recent article dealing

with teacher use of messaging defined use behavior as "the number of times a teacher uses messaging to communicate with parents" (Ho, Hung, & Chen, 2013).

Theoretical/Conceptual Framework

Fred Davis introduced the Technology Acceptance Model in 1989 as a way to describe the acceptance and use of technology (Davis, 1989). The model centred on Perceived Usefulness and Perceived Ease of Use as major determinants of the attitudes and intentions related with Use Behavior. The TAM model is widely used in the literature, with 34,478 citations for the original 1989 and 2000 articles introducing TAM and TAM 2 in Google Scholar as of October 2015. Its construction over time has been logical and increasingly useful, from the original model that introduced the core determinants Perceived Usefulness and Perceived Ease of Use, to the following models that began to develop the determinants for these factors and the interactions between them.

Venkatesh and Bala (2008) updated the Technology Acceptance Model from version two to TAM 3, focusing on expanding the number of determinants that affect Perceived Usefulness and Perceived Ease of Use of an innovation, producing a positive Behavioral Intention followed by Use Behavior. Factors that influence Perceived Usefulness are Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability. Perceived Ease of Use is influenced by anchor variables (Computer Self-Efficacy, Perceptions of External Control, Computer Anxiety, Computer Playfulness) and adjustment variables (Perceived Enjoyment and Objective Usability). Experience and Voluntariness act as modifiers of Behavioral Intention. These terms are all defined in Chapter 3. The TAM 3 model is specifically designed for computer

innovations, which LMSs are, and the dimensions measured are quite comprehensive. This is believed to be the most appropriate model for this study. Figure 1 describes this conceptual framework.

Research Hypotheses

Hypothesis 1. Subjective Norm is positively and directly correlated with Image.

Hypothesis 2. Perceived Usefulness is directly and positively correlated with Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability.

Hypothesis 3A. Perceived Ease of Use is directly and positively correlated with Computer Self-Efficacy, Perceptions of External Control, Computer Playfulness, Perceived Enjoyment, and Objective Usability.

Hypothesis 3B. Perceived Ease of Use is directly and negatively correlated with Computer Anxiety.

Hypothesis 4. Perceived Usefulness is directly and positively correlated with Perceived Ease of Use.

Hypothesis 5. The influence on Perceived Usefulness of Subjective Norm is mediated by Experience.

Hypothesis 6. Behavioral Intention is directly and positively correlated with Perceived Ease of Use.

Hypothesis 7. Behavioral Intention is directly and positively correlated with Perceived Usefulness.

Hypothesis 8. Behavioral Intention is directly and positively correlated with Subjective Norm.

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Figure 1. Technology Acceptance Model Conceptual Framework (Venkatesh & Bala, 2008)

Hypothesis 9. The influence on Behavioral Intention of Subjective Norm is mediated by Experience.

Hypothesis 10. The influence on Behavioral Intention of Subjective Norm is mediated by Voluntariness.

Hypothesis 11. New to the model, it is anticipated that Behavioral Intention is directly and negatively correlated with Overload.

Hypothesis 12. New to the model, Behavioral Intention is directly and negatively correlated with Change Fatigue.

Hypothesis 13. Use Behavior is directly and positively correlated with Behavioral Intention.

Significance/Importance of the Study

This study deals with the technology used to facilitate blended learning in Adventist higher education. It is clear that education is a critical resource to all nations, and therefore the assistive technology is something to which educators must pay careful attention. Desirable educational outcomes are closely tied to decisions made regarding LMSs. LMSs can be costly purchases for institutions, and the process of change can be very upsetting if it not handled correctly. The introduction of LMSs can be disruptive even if handled well. The intention of faculty to implement a Learning Management System into their practice depends on key factors, which, if understood, facilitate the implementation process.

The Seventh-day Adventist Church operates an educational system of universities, high schools, and elementary schools. There has been research involving TAM with pre-service teachers (Teo & Noyes, 2011). Also, a similar study was done evaluating faculty

adoption of LMSs using the TAM while this dissertation was being prepared (Fathema &

Sutton, 2013). However, there is a lack of research into Learning Management Systems

within Adventist higher education. As such, this study is both significant and important in

providing results and information that Adventist administrators can consider as

specifically applicable.

Assumptions

It is assumed that individuals involved in education would accurately be able to

reflect on their perceptions and experiences with LMSs and would be able to remember

and share those feelings in a survey format. It is also assumed that Adventist institutions

in North America would have useful data regarding the usage of their LMS and would be

willing to share it for the study.

Research Design

This research study was an empirical, non-experimental, descriptive and

confirmatory quantitative study, using survey methods to test and build on the TAM3

within the context of a sample of North American Adventist university faculty. As a

correlational, cross-sectional study, it used bivariate and partial correlations, regressions

and path analysis to evaluate and establish the links that would form the final revised

version of the model.

The dependent variable of this research study was the Use Behavior of faculty as

they integrate the university's Learning Management System into aspects of teaching

classes at the university. In order to evaluate this variable, examination was made of

subjective components of the level of integration. Originally the intention was to combine

subjective and objective components, using the objective statements to correlate self-reported statements. However, it proved impossible to collect objective data from all nine institutions, and the information that was available was not consistent across institutions.

To assess the subjective component of the dependent variable, usage behavior, faculty members were asked for each of the following uses of LMSs, to agree or disagree with statements that assess their use. A seven-point Likert scale was used.

These are the areas examined in the above-described questionnaire:

a.   Sharing content and class documents
b.   Using calendar function
c.   Using grade book
d.   Administering quizzes
e.   Administering tests
f.   Using message boards and discussion areas
g.   Posting announcements
h.   Employing dropbox for class assignments

Two additional questions were asked, to evaluate the degree of use, and to determine whether a teaching assistant used the LMS on the faculty member's behalf to determine if this external factor influenced faculty use.

The quantitative evaluation focused on determining the dependent variable, which was measured using subjective data as described above. The dependent variable is integration of the LMS into teaching practice measured using a 7-point Likert scale.

The self-report portion evaluated the perceived use of the current system using the seven-point Likert scale. The Likert scale is an excellent scale and is easy for respondents to use: it allows for strong negative and strong positive reactions, more and less than neutral, and more and less than extreme. Every number has a meaning and is anchored in comparison to the central and extreme values.

The second portion of the questionnaire evaluated the elements of the TAM 3 model so that the behavioral intentions could be compared with the determinants.

Limitations of the Study

Some North American Seventh-day Adventist universities chose not to participate in this study. Nine of the thirteen universities consented to have their faculty participate in the process. Another limitation was that some faculty may not have used LMSs and therefore would have no contribution towards this topic. This did not appear to be the case based on the data.

Delimitations of the Study

The study was delimited to 13 Seventh-day Adventist institutes of higher education in North America where there is the possibility of web-enhanced instruction using LMSs. These universities were Andrews University, Burman University, Adventist University of Health Sciences (AUHS), Kettering College, La Sierra University, Loma Linda University, Oakwood University, Pacific Union College, Southern Adventist University, Southwestern Adventist University, Union College, Walla Walla University, and Washington Adventist University. Of these, AUHS, Kettering, Oakwood, and Walla Walla declined to participate.

Summary

This study examined the relationship between innovation factors and the intention of faculty to adopt LMSs, and their actual adoption of LMSs in their daily practice. This study is relevant and important because LMSs have the potential to provide strategic advantage and to incur significant costs for universities as they seek to accomplish their

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educational missions. This quantitative study focused on the dependent variable, the use behavior of faculty with respect to LMSs, in relation to the independent variables Perceived Usefulness, Perceived Ease of Use, and the other determinants in the TAM 3 model as well as Overload and Change Fatigue.

The study involved the use of a SurveyMonkey questionnaire, made available through emailed SurveyMonkey invitations to the faculty on nine selected Seventh-day Adventist campuses in North America.

Bivariate correlations, partial correlations, multiple regression, and path analysis revealed the factors strongest in facilitating intention to innovate by faculty when it comes to adopting LMSs in their daily practice. A clear understanding of the factors that influence use behavior by Adventist faculty are of value to Administrators and Computer Services personnel as they seek to make the most of the substantial investment that a Learning Management System represents.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

The chapter begins with an understanding of what Learning Management Systems

are and why they are important in education. A number of LMSs and the benefits or

affordances that they provide to faculty will be explored. Given the number of factors

that influence the adoption of LMSs, different models of innovation, technology

differences, and contextual factors will be evaluated before moving onto different

theories and models that explain the factors that affect innovation decisions. The

development of TAM 3 will be covered. Finally, barriers to adoption, and aspects of

organizational change will be examined.

What are LMSs?

A Learning Management System is defined as "software that has been used in a

learning content presentation which has a significant role and complexity in [an] e-

learning environment" (Aydin & Tirkes, 2010, p. 176). An LMS, the successor to the

Course Management System (Ceraulo, 2005), "provides a place for learning and teaching

activities to occur within a seamless environment" (Unal & Unal, 2011, p. 19). This Web-

based technology enables faculty to both provide learning materials and track

participation and progress of students (Chapman, 2005; Falvo & Johnson, 2007). In

addition, LMSs have the ability to store information so that many courses can access the same content (Ceraulo, 2005).

LMSs allow faculty and students to interact together in a virtual space to facilitate web-enhanced, blended and online courses. Using the web, faculty have the ability to create, store, and share content and students interact with that content and information generated through the education process.

History of Learning Management Systems

The genesis of Learning Management Systems was early in the 21st century. Robbins (2002) defined four stages of Learning Content Management Systems, primarily used by companies. The first stage, generic content libraries, included web-based content that would be available to employees at all times. Essentially, content libraries made available on the World Wide Web the information that had previously been kept on CD-ROM. The second stage, termed learning management systems, became more strategic, linking the learning to the actual needs of employees, but still lacked the ability to easily deploy internally-authored courses. The third stage was outsourced e-learning platforms, freeing up companies from having to create their own proprietary content. Learning content management systems, the fourth stage, are the parallels to the course management systems found in higher education. They are more sophisticated in terms of what information can be provided about the learning taking place and the accountability learners have to their employer (Robbins & Judge, 2006).

Therefore, over time, LMSs have evolved from one-way information systems to dynamic information systems where all participants create knowledge and information. Further steps forward have been taken with the integration of social networking in

Learning Management Systems through Athabasca Landing (Anderson, Dron, Poellhuber, & Upton, 2013) and massive open online courses (MOOCs) (Daniel, 2012). While these represent new approaches to education, all 13 of the North American Adventist institutions still choose to use the traditional Learning Management Systems.

Why are LMSs Important?

Learning Management Systems represent a significant investment by educational institutions. They are such an integral part of learning that "no institution of higher learning will be able to do without either an Open Source or commercial version of the software" (Georgouli, Skalkidis, & Guerreiro, 2008, p. 238). LMSs facilitate online instruction, blended instruction, and web-enhanced classes. Benefits include the ability to store items in a repository for use in multiple courses, and the advantage of allowing students to create electronic portfolios from among their varied courses (Ceraulo, 2005). A third advantage is the ability for technology-driven personalization, "self-paced, diagnostic-driven – with the ability to adapt to a student's specific learning styles, interests, and background" (Demski, 2012, p. 34). A fourth advantage is called "efficient workflow integration" (Ceraulo, 2005, p. 6) in which the software makes it easier for users to manage their emails, grades, assignments, and other aspects of their educational experience. Effectively used, LMSs do not simply automate the educational experience, but transform it strategically to make better use of human resources and enhance the user experience.

LMSs contribute significantly toward improving the educational experiences of students by providing an environment where learning can take place in a customized format, and where students can access learning on their own timetables, 24 hours a day.

Properly configured, teachers can share learning objects such as assignments with others and benefit from the development activities of others.

LMS Options

Blackboard is the largest player in the higher education marketplace with its *Learn* product. In Spring 2015 *Blackboard Learn* held 46% of the marketplace, compared to *Moodle's* 16.2%, *Canvas's* 17.2% and *Desire2Learn's* 13.1% (EdTech, 2015). Higher education in the province of Alberta uses the following LMSs: *Moodle*, *Blackboard Learn, Blackboard Vista (WebCT)*, and *Desire2Learn* (Delinger & Boora, 2010). Among the North American Seventh-day Adventist universities, the following are in use: *Canvas, Desire2Learn, Moodle*, and *Blackboard* (G. Ketting-Weller, M. Beal, C. Hill, J. Ferdinand, B. Young, D. Handysides, B. McArthur, S. Hornshaw, personal communication, August 2011). There are other sources of software, including *Angel* (Ceraulo, 2005), and *OpenClass*, the collaboration between Google and the publisher Pearson (Fischman, 2011).

The market for LMSs is so competitive that the various organizations fight even through litigation and patent battles for whatever advantage they can achieve. In July 2006, *Blackboard* sued *Desire2Learn*, claiming that a patent had been infringed upon. *Blackboard* tended to win in the courts but tended to lose when *D2L* appealed the patents at the Patent Office (Spelke, 2011).

Given that creators of Learning Management Systems have a profit motive, and some technology firms have been known to promise more than they can deliver, it falls to universities to do due diligence and effectively evaluate the software options available to them. They must know what features are of value to them and how best to evaluate them.

Caminero, et al. (2013) presented a twofold evaluation that would be helpful when selecting from among LMSs. First, institutions would want to evaluate performance to compare the demands of the LMS on the hardware and system resources. Second, institutions must also evaluate performance from the point of view of the administrators. Both sides are critical. It is interesting to note in 2003 that few of those who sold and managed e-learning solutions had ever taken an online course (Hall, 2003). This oddity is likely no longer the case, but it is historically telling the kind of disconnect that existed in the industry at that time.

While countries in North America are not considered developing, it is still instructive to learn from the findings of Cavus (2013), who recognized the challenge of correctly evaluating LMSs. A solution of a software program that automates the process of evaluating LMSs was proposed and developed. Responses to questionnaires demonstrated that instructors were satisfied with the computer-aided process of LMS evaluation.

The typical selection process for an LMS involves the establishment of a selection group, the establishment of product requirements, the development of a Request for Proposal, the selection of finalist vendors, product demonstrations and pilot studies, review of stakeholder input and final selection, and final recommendation being passed on to leadership for purchase (Spelke, 2011). It is important to realize that the selection process of an LMS is a critical one, as the system is very expensive, the amount of time invested to train users, and the ongoing expense are a tremendous investment. In addition, the strategic advantage or leveling of the playing field that the technology is expected to provide, is essential for the institution to achieve its mission statement.

Aspects of LMSs

Learning Management Systems are complex systems that allow communication of different forms to be expressed. De Smet, Bourgonjon, De Wever, Schellens, and Valcke (2012) adapted the five levels of LMS interaction of Hamuy and Galaz (2010) at the higher education level into three informational levels and two communicational levels for LMSs in the high school environment. The most basic level, presence, contains information contained in the course syllabus. The second level, informative interaction, includes elements such as calendar and announcements. The last informational level, consultative interaction, gives access to information for which there is no feedback, such as readings and presentations. The first communicational level, communicational interactivity, involves access to synchronous or asychronous communication, and the final level, transactional interaction, involves the creation of complex interactions that aid in the social construction of knowledge, such as chat rooms. The study found that informational use was a precursor to communicational use of LMSs. One of their findings was also that using log files rather than ascertaining reported LMS use would be a more accurate method of gaining data. Finally, ease of use and access to support were also factors promoting successful acceptance.

Understanding that LMSs are complex systems, with various interconnected elements and levels of increasing complexity, is useful in understanding the nature of the adoption decision. Adoption by faculty members is not always an all or nothing venture, but does involve faculty choosing to use communicational levels from the most basic up to the most complex.

Affordances of Learning Management Systems

Affordances help to express the benefits of technological innovations. Gibson (1977) first proposed the theory in which he identified affordances in an environment as elements which, in combination with an actor, provide something good or bad. In the context of human-computer interactions, affordances indicate how things can be designed so that users can easily determine what they provide (Şahin, Çakmak, Doğar, Uğur, & Üçoluk, 2007). Affordances are not actual effects, but potential effects. For example, having email embedded within an LMS may lead teachers to believe that students will respond by asking frequent and deep questions. This benefit may never materialize (Dillenbourg, Schneider, & Synteta, 2002).

To overcome barriers to adoption of LMSs by teachers, it is important to understand the teachers' beliefs as well as the affordances they are able to identify and link to their own teaching practices (Steel & Levy, 2009). Understanding the relationship between beliefs and affordances brings to realization the challenge with LMS adoption that every academic division may use the various aspects of the LMS in different ways and find that their particular interactions with different features may give different levels of affordances. For example, Economics may be more suited to the multiple choice testing functionality of an LMS, while English may prefer to use essay testing and therefore the ability of the LMS to automatically grade multiple choice tests online would not offer the same affordance to each discipline, according to Steel and Levy.

The key learning from affordances is that faculty will not necessarily understand the affordances of the technology and will may someone who is an expert, such an instructional support individual, to assist them in unfolding and interpreting the

technology. Research shows that some users may not even be willing to try technology without the help of instructional support (Stark, Mandl, Gruber, & Renkl, 1999).

<center>Social Technology Appropriation</center>

Simoes and Gouveia (2011) extended the theory of affordances to embrace the idea of appropriation. While affordances express the value experienced in the interaction between an individual and a benefit of an innovation, technology appropriation describes "the use of cognitive and physical resources by individuals in their daily practices" (Simoes & Gouveia, 2011, p. 22). While affordances recognize the fit between the user and the innovation's elements, appropriation is a type of internalization, in which a person takes ownership of the technology that they had previously not taken. At the same time, users become more proficient in the LMS tools in the context of the social practice that is their university teaching experience with students.

According to Simoes and Gouveia (2011), there are attractors and repellents for technology appropriation. Attractors increase the likelihood of appropriation while repellents push potential users away from enjoying and internalizing the innovation. The attractors are convenience, utility, and fashion (very similar to the ease of use and usability dimensions of the TAM). Repellents are cost, difficulty in use and learning, and entropy. Appropriation arises as a result of interactions between context (the social environment where people live and work), personal needs and desires, and the technology.

Simoes and Gouveia (2011) identify technology as a set of tools that facilitate learning in a social-cultural system. The technology affordances involved allow the connection and social rapport that LMSs can provide, collaboration in information

discovery and sharing, the ability to work together to create content, and the ability to bring information together and modify content. The introduction into the academy of digital natives, who have become immersed in technology before beginning high school, increases their ability to be involved in constructivist learning using information system technologies. A challenge for LMSs is that students have become very accustomed to using Web 2.0 technologies (blogs, wikis, podcasts, etc.) that exceed the ability of LMSs. This challenge exists because the majority of the control in LMSs resides with the faculty and administrators, while Web 2.0 places the control in the hands of the user.

<p style="text-align:center;">Movement to Open Source</p>

A particular trend in LMS change is the move toward Open Source software. Open Source is software that is freely available to the public for use, modification, and distribution ("Choices and challenges," 2008). While systems like *Blackboard* cost between $ 5,000 and $ 50,000 minimum per year (Products, 2012), Open Source software like *Moodle* is free ("Choices and challenges," 2008). Other advantages are that it is not dependent on one software company, that it cleansed of errors by many developers and experts, and the frequent updates (Aydin & Tirkes, 2010).

Open Source LMSs have advantages and disadvantages. Aydin and Tirkes (2010) evaluated several Open Source LMSs - *Moodle, Atutor, eXe, Dokeos*, and *Olat*. They compared these LMSs to analyze general features and compared those features among the four most preferred LMSs. In their evaluation, *Moodle* had the clear advantage over the other LMSs due to greater flexibility, superior usability, and features that increase frequency of usage. Sumangali and Kumar (2013) used Formal Concept Analysis (FCA) and concluded that of the Open Source LMSs they evaluated, *Moodle* was exceptional,

with more features than the others. FCA treats LMSs as objects and their features as attributes, and uses mathematics to compare and evaluate different systems.

The product lifecycle undergone by one department at the University of Muenster in Germany is documented by Dewanto, Grob, and Bensberg (2004). The authors sought flexibility in a multi-tier architecture, and the Application Service Provider model that would allow for economies of scale in the future. They chose to use a system known as OpenUSS and through the process realized that it was possible to create a suitable LMS using the available tools. They discovered the critical nature of skills in software engineering, as they had to make adaptations to the software to ensure it would work well in their environment. The biggest challenge they discovered was ensuring that the user interface would meet the requirements of all users.

So as far as LMSs go, there is a broad spectrum of available systems, with some movement away from commercial systems toward Open Source, and with movement from on-site server-hosted systems to cloud-based servers. With all of the transitions, organizations must go through the evaluation and selection processes for administrators and the implementation and adoption processes for institutions and their constituents.

Frameworks for Evaluating Learning Management Systems

To assist administrators in the process of selecting Learning Managements, frameworks for evaluation have been developed. Georgouli, et al. (2008) proposed a framework for introducing e-learning into a traditional course. Their framework consists of four parts: administration, content, activities, and community. Administration relates to the non-pedagogical elements, while the other three involve the design of the LMS to

ensure that the communication methods and activities support the content that is to be learned in the course (Georgouli, et al., 2008).

This framework leads to a model in which motivation and communication influence the three modules of information provision, knowledge activation, and knowledge application (Georgouli, et al., 2008). Information provision is about making existing learning materials available and accessible for users to read. Knowledge activation is the elements of the system that allow students to think – to recall, describe, and demonstrate – through the self-assessment elements of the system. The knowledge application module involves coaching so that students can use the skills they have developed in the prior two modules in order to complete new tasks.

Kim and Lee (2008) created and sought to validate a model for evaluating LMSs. Their model's key elements are instructional management, ease of use for the teacher, interaction, ease of use for the student, information guidance, accessibility and searchability of information, and evaluation, related to test management. Two overarching themes are screen design and technology (Kim & Lee, 2008). This model provides evaluators with factors that can be used to assess a variety of LMSs to determine which is most appropriate for the needs of the institution.

Another model is proposed by sociologist Barbara Wejnert. Her model sees successful innovation as a function of faculty differences (e.g. personal factors such as personality traits, workloads, and familiarity with technology), technology differences (e.g., differences in user-friendliness of Learning Management Systems, documentation, company-provided training), and contextual factors (university computer support, university cultural factors, and administrative directives) (Wejnert, 2002).

Adoption of Innovations

Findik Coşkunçay and Özkan (2013) observe that successful implementation of LMSs depends upon user adoption. The users can be faculty or students. Their research model looks at how compatibility, application self-efficacy, subjective norm, and technological complexity combine to influence two belief factors – perceived usefulness and perceived ease of use – which impact the behavioral intention – that is, the willingness to adopt a new behavior or innovation. The prediction is statistically significant with a predictive power (R^2) of 0.42.

Computer Self-Efficacy is a very important construct when it comes to innovation. Research has shown that Computer Self-Efficacy is significantly correlated with perceptions of usefulness, perceptions of ease of use, users' attitudes toward computers, intentions to use, actual use, and computer anxiety (Karsten, Mitra, & Schmidt, 2012)

Atsoglou and Jimoyiannis (2012) considered the use of information and computer technology at the secondary level. They found that teachers were aware of the benefits of the innovation but were not willing to integrate the technology into their practice. Key factors that facilitate implementation of the innovation are related to facilitating conditions within the school and teachers' self-efficacy when it comes to the technology itself. Key elements of the Decomposed Theory of Planned Behavior did not have a major impact on teachers' intention to innovate: perceived usefulness, perceived ease of use, compatibility, and normative beliefs.

According to Wejnert (2002), there are six factors related to the individual actor that influence adoption of innovations. Relating these specifically to our context, these

would be the educational institution of which the faculty member is a part, how familiar the faculty member is with the LMS technology, the level of status the faculty member has within the educational institution, socioeconomic characteristics of the faculty member, the faculty member's position in social networks, and personal characteristics (Wejnert, 2002).

Interpreting the Wejnert factors, it is evident that institution size will impact the rates of adoption. Familiarity reduces fear and makes people less likely to reject an innovation. High-status individuals in an institution have the power to influence lower-status individuals within their social circles. Institutions with more resources have greater access to innovations and greater willingness to take risks that involve innovations. An entity's ability to connect with others who have knowledge and experience with the innovation will have an impact on its willingness to adopt an innovation. Personal characteristics such as self-confidence and independence can affect the diffusion of innovations because those who are psychologically stronger are more independent as actors when it comes to making decisions about adopting innovations (Klinger, 2003).

Various frameworks are proposed for explaining the adoption of innovations. In this section, several models of adoption of innovation are examined. Many of them, like the Technology Acceptance Model, focus on the influence of Perceived Ease of Use and Perceived Usefulness. Barbara Wejnert's framework for adoption is also examined and the six factors that influence the intention of faculty to adopt new LMSs are expanded upon.

Two factors that influence user intention to use information technology are Perceived Ease of Use and Perceived Usefulness (Davis, 1989). Perceived Ease of Use is

the degree to which using a Learning Management System would be perceived to be effortless. Perceived Usefulness is defined as the degree to which a faculty member believes using an LMS would enhance his or her job performance. Davis proposed that Perceived Ease of Use influences Perceived Usefulness, which then modifies Usage, rather than the two factors being independent determinants of Usage. His classification of these two determinants of innovation came to be known as the Technology Acceptance Model. Davis discovered, in the context of electronic mail, that if a system is difficult to use, it might interfere with adoption of a useful system. However, no amount of ease of use would overcome a system perceived to be useless. These findings were examined by Adams, Nelson, and Todd (1992) who sought to replicate Davis' work on the user perceptions of ease of use and usefulness. Examining the psychometrics of the scales and evaluating the relationships between the variables, they confirmed the reliability and validity of the measurement scales. However, while the variable usefulness was confirmed in the first of two studies as an important determinant for system use, a second study had more mixed results, which were attributed to issues with statistical power.

Venkatesh (2000) explored some of the factors influencing Perceived Ease of Use in the Technology Acceptance Model. In his study, three elements were considered as determinants of Perceived Ease of Use: Internal Control (technological self-efficacy), External Control (facilitating conditions), Intrinsic Motivation (computer playfulness), and Emotion (computer anxiety). These factors are anchors that create initial perceptions about how easy a new system is to use. This model, when tested in three organizations, explained up to 60% of the variance regarding perceived ease of use for the system. An individual's general beliefs regarding the technology were more important in determining

ease of use, even after direct experience with the target computer system in the study. Later models would add determinants to Perceived Ease of Use and Perceived Usefulness.

While the Technology Acceptance Model and its two primary determinants of Behavioral Intention – Perceived Ease of Use and Perceived Usefulness – were foundational to the body of innovation theory, one of its founders, Bagozzi (2007), examined its limitations. Although TAM outperformed the previously developed Theory of Reasoned Action and the Theory of Planned Behavior, researchers ignored some of the problems inherent in its simplicity. First of all, the link between intention and behavior was seen by Bagozzi to be an untested assumption that exists in social science research. The focus on intention's impact on behavior ignores the gap between use and goal attainment. As a result, users typically actually use innovations in order to achieve one goal or another. Second, there is often a time lapse between intention and behavior, with many intervening factors affecting the final adoption behaviors. Finally, the orientation of decision makers toward trying to adopt a technology affects how they behave. Their commitment to the choice creates an orientation to support that commitment through action. Bagozzi is therefore focusing on goal striving rather than behavior change as the desired end of innovation.

According to Bagozzi (2007), a second key gap in the Technology Acceptance Model is between individual reactions to information and the intentions of those individuals. Many people can get information about the benefits of an innovation, but conversion into motivation to act differs from one person to another. Understanding how these multiple reasons to act are not converted into an intention is an important missing

part of the puzzle. In addition, technology acceptance needs to consider group, cultural and social aspects of decision-making and usage, for rarely are innovation decisions made in isolation, especially in higher education. Emotions and self-regulation had also been absent from the TAM. An updated version of TAM, TAM 2, includes Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability as determinants of Perceived Usefulness, and with Experience and Voluntariness as modifying factors (Bagozzi, 2007).

Subjective Norm is the pressure the faculty members feel from others in the institution to use the LMS. Image refers to the degree to which using the LMS is perceived to enhance one's status within one's institutional social group (e.g. among faculty). Job relevance refers to how relevant the Learning Management System is perceived to be to the faculty member's job. Output Quality refers to the degree to which a faculty member believes the LMS will help them teach well. Result Demonstrability refers to how tangible the results of using the LMS are. Voluntariness refers to how much choice faculty members believe they have in using the system (Venkatesh & Bala, 2008).

Legris, Ingham, and Collerette (2003) agree that the TAM model, and the updated version (TAM 2), are useful but suggest that it be integrated into a broader model that includes human and social change processes such as the strategies employed in implementation. When the update to TAM2 came, it expanded the model, but not in the direction of change processes as desired.

Venkatesh and Bala (2008) updated the Technology Acceptance Model to TAM 3, focusing on combining TAM 2 with a model of determinants of Perceived Ease of Use to create a new integrated model. In the new model, three new relationships are proposed:

Experience moderating the relationship from Computer Anxiety to Perceived Ease of Use, Experience moderating the relationship from Perceived Ease of Use to Perceived Usefulness, and Experience moderating the relationship from Perceived Ease of Use to Behavioral Intention. So, now the TAM 3 has two main factors influencing Behavioral Intention: Perceived Usefulness and Perceived Ease of Use. Factors that influence Perceived Usefulness are Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability. Perceived Ease of Use is influenced by anchor variables (Computer Self-Efficacy, Perceptions of External Control, Computer Anxiety, Computer Playfulness) and adjustment variables (Perceived Enjoyment and Objective Usability). Experience and Voluntariness serve as modifiers of Behavioral Intention.

Bagozzi (2007) proposed a Technology User Acceptance Decision Making Core of universal elements where goal desire influences goal intention influences action desire influences action intention. Causes and constraints influence the two desires. Factors considered causes are superordinate goals, relative advantage, job fit, outcome expectancies with relation to the goal desire and effort expectancy, performance-based contracts, and self-regulation (both reflective and reflexive) influences the transitions between each desire and its corresponding intention. Action intention leads to the effects of the innovation introduction.

Faculty are more or less willing to adopt a particular LMS technology as they perceive differences between the systems and sense compatibility between the LMS and their teaching and class management styles. Ease of use and features and functionality top the list of selection criteria for LMSs (Siemens, 2006).

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Contextual Factors

Contextual factors are also known as "externalities" (James, 1993, p. 410) and are part of the environmental context that surrounds decisions. Because they impact the practicality and benefits of adopting an innovation, as well as the willingness and ability of actors to implement, contextual factors have the ability to determine whether an innovation will be accepted or not (Wejnert, 2002). Contextual factors include university computer support, university cultural factors, and administrative directives. These factors differ from university to university and create the environment within which individual innovation decisions are made. One study found that one of the most common reasons for adoption was because of top-down directives to innovate while a strong second was because of student demand (Samarawickrema & Stacey, 2007). Contextual factors also include interpersonal influences, expectations from the community and other constituents, habitual practices of individuals, advertising decisions, costs, and technological possibilities (Kientzel & Kok, 2011).

Implementing LMSs

Implementing LMSs "is usually risky, frustrating, and expensive" (Dagada, 2013, p. 151) and requires special care to ensure success. A particular challenge exists because LMS vendors have not provided organizational design and change management tools, the very deficits identified as the largest hurdle to successful installation and integration (Oehlert, 2010). Zakaria, Jamal, Bisht, and Koppel (2013) recognized that LMS implementation often results in a lack of educator enthusiasm to embed all of the features of the LMS in their courses. Typically lecture notes would be uploaded, announcements posted, and grades shared, but other more involved elements of the system excluded.

Bozalek, Ng'ambi, and Gachago (2013) suggest that implementation shortcomings might be because technologies have not kept their promise of transforming existing practices. McLean (2002) further suggest that the focus on getting academic staff on board to use LMSs overshadowed concerns about the quality of the learning experience.

Several frameworks have been proposed to help administrators to navigate the process of implementation in an effective ways. Dagada (2013) proposed the steps of planning, system study, system analysis, integration, content migration, and training and support to ensure all of the details are effectively processed during the implementation. Each step is detailed and has identifiable outputs such as a project team, various reports, and training and support activities. A standardized process helps to reduce the risks of the implementation.

In the context of organizational LMSs, Dobbs identifies several key steps in choosing an effective Learning Management System (Dobbs, 2002). Factors that must be taken into consideration include the capabilities of the university's IT staff, the degree of need to customize, and the choice of vendor. Because the investment is so large, making the right choice is critical. Specific steps identified as good practice guidelines by (Buchan, 2010) include ensuring sustainable funding, a centralized project-based approach, involving multiple stakeholders, and ensuring ongoing maintenance and support following implementation.

An evaluation of the change from *WebCT/Blackboard CE* to *Blackboard Learn* at Nipissing University (Ryan, Toye, Charron, & Park, 2012) revealed that face-to-face training should be offered, instructors should be involved in the process, and 99.9% server uptime should be guaranteed. Ryan et al also recommended ensuring that the

timing of the roll out be appropriate (well in advance of September, for educational institutions), and that technical support be constantly available to assist instructors in using the new system.

Further, there needs to be cooperation between the opinion leaders of the organization, and the change leaders tasked with bringing the implementation to fruition. Bozalek, et al. (2013) recommend the purposeful creation of an enabling environment by having opinion leaders and change leaders communicate well with one another.

Emerging Trends in LMSs

As an innovation, Learning Management Systems respond to changes in the environment. Some recent trends in LMSs include combining LMSs with virtual worlds like *Second Life*, a greater emphasis on learner-controlled learning using social media, support for Massive Open Online Courses, authoring capabilities, support for team-based learning, tools that enable the analysis and management of competencies, and integration with video and other multimedia (Berking & Gallagher, 2013). The authors suggest that the idea of logging into a one-stop shop LMS is receding into the background and that learning objects that specialize in meeting specific needs may arise as a new trend. For instance, *Canvas* and *Desire2Learn* both allow for an optional Learning Object Repository that allows for sharing of learning objects among users.

Changing LMSs

Educational change is influenced by teachers' perceptions of risk. The greater the feeling of risk that a new technology will bring, the greater the reluctance of teachers to embrace the new technology. Howard (2011) discovered that the willingness of teachers

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to accept risk is linked to teachers' affect for technology and the value of the technology in teaching. The appreciation and openness of teachers, and the positive feelings that they have toward technology, combined with the positive impact the technology can have on the educational experience increases the willingness of teachers to innovate with technology.

The impact of externalities cannot be ignored. Cahir, McNeill, Bosanquet, and Jacenyik-Trawöger (2014) sought to explore the process of implementing *Moodle* at an Australian university. They discovered that the environment in which more casual labour was being used in higher education represented a barrier to managing this kind of change. An insecure employment environment is a factor that makes successful LMS change more challenging.

<div align="center">Innovation Theory</div>

Much study has been undertaken regarding the topic of innovation and how technological innovation impacts organizations seeking to move forward. Everett Rogers (2003) is perhaps the grandfather of innovation, through his book *Diffusion of Innovation*, which is now in its fifth edition. Rogers identified five groups of people whose behaviors enable innovations to move from being risky to being well accepted: innovators, early adopters, early majority, late majority, and laggards. In his latest edition, he looked at how the Internet has sped up the rate at which innovation occurs. The book also identifies four main elements that influence the speed of adoption of a new concept: the idea itself, the communication channels, the passage of time, and the social system within which the innovation is arising. Understanding and using Rogers' principles can assist administrators in understand their faculty and helping them to move toward adoption.

Industrial Innovation

Hall and Khan (2003) recognized that innovations can only improve economic growth when they are widely adopted within the society and used by its consumers. Individual decisions are made, weighing the possible benefits against the possible costs of innovations. The challenge is that both of these are uncertain, with the benefits being more uncertain than the costs (Cawsey, Deszca, & Ingols, 2015). A further challenge is that the costs are often immediate, while the benefits flow over the life of the innovation. The aggregation of these decisions is the process known as diffusion, and the outcome of the decisions isn't necessary "buy/don't buy," but may rather be "buy now/buy later." Hall and Khan also brought about the importance of understanding network effects, in which the value of a network increases to the individual user as the number of users increases. Therefore, the more users of an LMS, for instance, in a consortium of universities, the greater the benefit to each individual university and user.

Brand and Huizingh (2008) evaluated the impact of the current level of adoption on various determinants of adoption and on the intention to further adopt. Using 98 small and medium-sized businesses in the Netherlands, their findings indicated that companies at the basic level of e-commerce had significantly larger effects in knowledge and satisfaction. So the typical determinants of adoption (knowledge, satisfaction, potential value, and implementation) had less of an effect as the level of adoption increased. Also, the current adoption level was found to have a highly significant positive direct effect on the intention to adopt in the future.

Learning and Innovation

Cohen and Levinthal (1990) evaluated the innovative capacity of organizations by looking at their ability to recognize the value of new information, assimilate it, and apply it to their operations. This ability they called a firm's absorptive capacity, and identified a relationship between absorptive capacity and the firm's prior related knowledge. To be successful in future innovation, it is important for firms to invest early in particular areas of expertise that will, in the future, be related to the innovation they may choose to move forward into.

Factors Affecting Innovation Decisions

In choosing the TAM 3 as the foundation for this study, several approaches to evaluating the adoption of innovations were examined: Theory of Planned Behavior, UTAUT, and the Theory of Reasoned Action, among them.

Ajzen (1991) identified a model called the Theory of Planned Behavior, a theoretical framework of three key factors that influence whether or not an innovation will be adopted and used. Attitude Toward Using, the first, has to do with how favorably a person views the desired behavior. Subjective Norm, the second, has to do with the sense of peer pressure to conform to the desired behavior. Perceived Behavioral Control, the third, relates to how easy people perceive it will be to perform the desired behavior. Morris and Venkatesh (2000) applied this framework to age in a study that found that age does influence technology adoption and usage. For younger workers, attitude toward the new technology was a stronger factor, while older workers found subjective norm and perceived behavior control to be more important when deciding on initial adoption. In general, Morris and Venkatesh (2000) found that younger workers' adoption was

influenced more heavily by attitudinal factors while older workers tended to be more motivated by social and process factors.

Bagozzi, Davis, and Warshaw (1992) developed a theory of innovation called the Theory of Trying (TT) that suggests that the learning process can be an impediment to adoption when it comes to computer technology. Picturing the performance of a behavior as a goal, this theory seeks to understand the factors likely to make decision makers' behaviors into goals. The results of this study demonstrated that users form multidimensional attitudes toward the learning process that is involved: attitudes toward success, attitudes toward failure, and attitudes toward the process of learning the technological innovation effectively. The Theory of Trying performed significantly better than the Theory of Reasoned Action and the Technology Acceptance Model.

In a study focused on mature consumers and innovation resistance, Laukkanen, Sinkkonen, Kivijärvi, and Laukkanen (2007) examined mature consumers in the mobile banking context. Using an Internet survey, the authors found that the value barrier is the most intense barrier to adoption for all consumers, but that risk and image are especially important to the aging consumers. The lesson to marketers is that communication strategies are critical to provide the consumer with all of the information needed to take the step to innovate. As far as risk is concerned, getting feedback from mature consumers is a good strategy to enable customization of the innovation to meet their needs.

Brown, Massey, Montoya-Weiss, and Burkman (2002) discussed innovation particularly in the area of information technology. They separated voluntary adoption environments from situations in which adoption was mandatory. As such, they discovered that there were differences between voluntary and mandatory use situations.

When the situation is voluntary and employees perceive that the technology is not very useful, they will choose not to adopt. However, when the technology is mandatory and the perception of usefulness is low, attitudes will be negative and the response is more complex than simply "technology use."

Venkatesh, Morris, Davis, and Davis (2003) did a comprehensive analysis of eight different models of information technology acceptance research: theory of reasoned action (1975), technology acceptance model (1989), motivational model (1992), theory of planned behavior (1991), combined TAM and TPB (1995), model of PC utilization (1991), innovation diffusion theory (1991), and social cognitive theory (1995). The study included the classification of voluntary and mandatory uses of new technology. Having reviewed and compared the eight competing theories, the authors formulated a Unified Theory of Acceptance and Use of Technology (UTAUT). In this theory, seven factors are combined with voluntariness of use: performance expectancy, effort expectancy, social influence, gender, age, and experience. In the model, these all influence behavioral intention, which influences use behavior. One observation is that facilitating conditions directly moderate use behavior. A number of constructs influence each factor. Testing this model with the original data and cross testing it with new data from the original organizations validated the UTAUT model. The UTAUT was able to account for 70% of the variance in usage intention, improving significantly over all of the original eight models from which it was derived (Venkatesh, et al., 2003). Most of the relationships identified in this model were supported by Esteva-Armida and Rubio-Sanchez (2014) One challenge with this model, however, is that it has "41 independent variables for

predicting intentions and at least eight independent variables for predicting behavior." (Bagozzi, 2007, p. 245) This makes it very complex for the researcher seeking to use it.

Yang, Lee, and Kim (2012) used the UTAUT model and the innovation diffusion functions of introduction, growth, maturity, and decline to compare innovation adoption in Thailand, a developing, and South Korea, a newly developed country. They discovered that the diffusion patterns and factors were different between the two countries. Therefore, care must be taken to understand whether a nation is developed, newly developed, or developing when seeking to predict the innovation patterns will be seen.

Recognizing that most research about innovation centers on the relationships between attitudes, intentions, behaviors, and the factors that lead to these, Seligman (2006) attempted a sensemaking approach to decipher how these relationships develop and how adoption actually happens. Sensemaking is defined as "taking action, extracting information from stimuli resulting from that action, and incorporating information and stimuli from that action into the mental frameworks that guide further action" (Seligman, 2006, p. 109) Sensemaking was compared to the various stages of Rogers' Innovation-Decision Process Model, and with Davis' Technology Acceptance Model and Ajzen's Theory of Planned Behavior. Sensemaking's stages of need-based identity construction, pursuit of stimuli, reconstruction of identity in relation to adoption, construction of beliefs to frame outcomes, seeking social support for decision, identifiable actions, trial adoption, stimuli from experience, reinvention through sensemaking, and confirmation all parallel the stages of the IDPM. Sensemaking provides a lower-level view of the activities in the other models and provides more depth in understanding of the adoption process.

Slowikowski and Jarratt (1997) examined the impact of culture of adoption when it came to high tech products. Culture is understood to define socially acceptable norms, but is challenging to decipher since it is defined differently in different places and there isn't a consistent perspective on its impact. This study looked at emigrants from Poland and Vietnam to Australia and discovered that there were significant differences between the two nationalities when it came to ownership of appliances. Sixty-two percent of Vietnamese were measured to own mobile phones compared with Nineteen percent of Polish respondents. None of the Vietnamese surveyed claimed they would not live without any appliance. When introduced to a potential long-distance service allowing connection to their home country, there was a statistically significant difference between the 66% of Poles unwilling to consider and the 68% of Vietnamese willing to consider the concept. The conclusion of this study was that culture and nationality indeed impact technological adoption.

Hwang (2012) looked at innovation involving Eastern (Japanese) and Western (American) cultures. Targeting enterprise systems and using innovation diffusion, self-determinant, and Hofstede's cultural dimension's theories, Hwang evaluated how innovation impacted cultural differences. The three significant hypotheses, searching for a stronger effect of personal innovativeness in IT on intrinsic motivation in Japan, a stronger effect of personal innovativeness in IT on intention to use in Japan, and that intrinsic motivation would have a stronger effect on intention to use in the United States were all significant at the $p < 0.001$ level.

Although the Theory of Reasoned Action has been eclipsed by other theories in terms of its ability to explain variance, Mishra, Akman, and Mishra (2014) use it to

evaluate the adoption of Green Information Technology (GIT). Their study discovered that behavioral intention had a positive effect on actual behavior. The number of years of experience as an IT professional was not a factor in the decision to adopt GIT. Organizations that want to promote GIT decisions should therefore make employees aware of information related to environmentally-friendly technology choices.

Kozma specifically looked at innovation in higher education institutions and discovered that the particular high degree of autonomy and lack of accountability gives faculty power to choose their degree of innovation (Kozma, 1985). This, unfortunately, does not always result in the innovation choices that are best for students. In addition, he indicated that faculty was most influenced by the social network – the success or failure of innovations by their fellow faculty.

Findlow (2008), thirteen years later, examined the relationship between accountability and innovation. In higher education, the emphasis on accountability has increased, having a stifling effect on innovation. The standards that define what quality is in education influence the risk profiles that faculty place on the act of utilizing different innovations.

Nanayakkara (2007) studied user acceptance of LMSs within tertiary institutions in New Zealand to understand why the technology tended to be underutilized. Three key groups of factors were uncovered through the survey: individual (characteristics and perception), system (LMS characteristics and external system characteristics such as availability and reliability of infrastructure), and organizational (support such as training and characteristics such as strategy, culture, and leadership). Evaluating the different factors affecting adoption, this study finds that system and organizational factors (release

time for staff, ease of use, perceived usefulness, training and support, and infrastructure reliability) are the most important for adoption.

Among personal characteristics is the idea of whether or not the faculty member is a "digital immigrant" or a "digital native" (Prensky, 2005). Digital natives represent the students taught today who were born into the digital era and grew up speaking the language of digital devices. Immigrants represent most teachers, who had to immigrate into the land and language of the technology upon which LMSs are built. Being an immigrant increases self-confidence. A later maturing of the concept by Prensky now recognizes "digital wisdom", the ability to use technology to complement existing decision-making and abilities (Prensky, 2009). This is a skill that does not rely on age, but suggests that it is possible for those born before the digital age to be competent and excel with technology.

Mlitwa and Van Belle (2010) proposed a framework for researching adoption of LMSs using activity theory as the basis. Activity theory sees an information system as an activity system joined by interactive parts and within a learning context. Applying the activity theory-based framework to analyzing LMSs in higher education institutions, the authors focus on how the various subjects have different motives and goals that are in tension with one another. Mediating the work of the LMSs in teaching and learning are several factor: individual environment context aspects, organizational context aspects, and the tools that teachers and students can use as the system transforms motives into the desired outcomes.

The individual environment contexts include individual goals, perceived usefulness, perceived ease of use, nature of task, access to tools, degree of empowerment,

and social context. The organizational context includes the technological frames of reference, organizational culture, users and the information technology division, organizational goals, and policies and pedagogy. Teachers use the LMS to facilitate instruction, learning, and communication. Students use the LMS to learn, for self-assessments, to access content, and submit exercises. The desired outcomes are effective teaching and quality learning. Activity theory sees the activity as the main unit of analysis (Mlitwa & Van Belle, 2010).

<div align="center">Evaluating Adoption Perceptions</div>

Moore and Benbasat (1991) developed an instrument for measuring the different perceptions people have toward adopting information technology innovations. Their study used Rogers' five attributes along with a construct measuring how voluntary the usage was. As part of the process of developing their scale, they divided Rogers' observability into two distinct constructs, result demonstrability and visibility. The first evaluates the degree to which the user can see the impact of the usage, and the second evaluates the degree to which others can see the impact of the use.

Moreau, Lehmann, and Markman (2001) identified the gap in the research where the psychological processes undergirding individual adoption decision existed. Using the knowledge transfer paradigm, they found that existing knowledge and innovation continuity influence the adoption process. They also indicated that the relationship between base knowledge, consumers' comprehension, and their perception of an innovation was quite complex. Another finding was that base knowledge in a related area had a positive effect on the discontinuous innovation under study.

Iivari (2005) tested the DeLone-McLean Model of Information System Success on a mandatory information system. The model is based on the assumption that "system quality and information quality, individually and jointly, affect user satisfaction and use" (Iivari, p. 9). System quality and information quality are desired characteristics of the respective information system. User satisfaction and use combine to create individual impact that produces organizational impact. The evaluation of the model found that the paths from the two qualities to user satisfaction and on to individual impact were as hypothesized in the model. However, the paths from the qualities to actual use and from actual use to individual impact were not significant. This means that quality produces satisfaction, but quality doesn't necessarily produce use. Users can enjoy an information system without actually adopting it.

Barriers to Adoption

Several barriers exist to hamper the adoption of new technologies, particularly in the area of higher education. Introducing adaptive learning technologies, such as Learning Management Systems, comes with the expectation that more students will be educated at a lower cost with at least similar, but hopefully better educational outcomes (Bacow, Bowen, Guthrie, Lack, & Long, 2012). In evaluating the structures in educational institutions, it is important to realize that some structures may be both barriers to and drivers for change. As such, careful analysis is required to know how to manage the structures (Svanström, et al., 2012).

There are many barriers to adoption of online learning system, Learning Management Systems, and similar technology. These barriers are dangerous because the fear, panic and skepticism they create can lead to resistance, disengagement, and burnout

(Auster & Ruebottom, 2013). Many barriers are related to the response of faculty to the technology. Some faculty appreciate the relationships they have with students and feel that the technology will disrupt that relationship, creating distance between them and their students (Bacow, et al., 2012; Francis & Shannon, 2013). Another concern is that the technology will reduce their job security, as the online systems are perceived to replace faculty jobs (Bacow, et al., 2012; Francis & Shannon, 2013; Shannon, Francis, & Torpey, 2012).

A third barrier to entry is the perception that preparing for an online course, including the design of the course syllabus, takes more work than for a traditional course. For sessional, or contract teachers, this is particularly concerning, since it requires an upfront investment in a course that they may only be paid for once (Bacow, et al., 2012; Shannon, et al., 2012).

At times, instructional designers create the electronic side of courses, and in those cases, some faculty members are reluctant to teach courses they don't psychologically own, and courses they cannot customize. (Bacow, et al., 2012). Veteran teachers, in particular, representing 40% of teachers (Orlando, 2014), are unwilling to adopt and integrate new technologies into their teaching practice. Change fatigue, which will be discussed shortly, and knowledge insecurity, are dilemmas that veteran teachers face as they consider new technologies (Orlando, 2014).

Among the externalities affecting adoption is the political climate. Concerns about cutbacks and shutdowns create an uncertain political climate where adoption is less likely (Samarawickrema & Stacey, 2007).

An integrative model of the factors limiting the adoption of innovation (MacVaugh & Schiavone, 2010) looked at several factors that influence when new technology will not replace older technology. As far as technology is concerned, when users perceive the utility of the innovation to be less than the older technology, when the innovation is so complex that it causes users to focus more on the overall effectiveness rather than on the newest features, and when using older technologies with other items leads to higher total utility than when using newer technologies, new technologies will fail to replace the older technology. When it comes to the social structure, when context makes it more difficult to access the technology, when the general orientation toward using the innovation is negative, and when the contagious nature of the new technology is too weak to push the existing norms out of the way, the new technology will not replace the old. In the domain of learning, when the capacity to learn is limited or the access to education is limited, when what the users learned in order to use the older product doesn't help them with the innovation, and when the switching costs are high, then newer technology will not replace the older technology. In summary, this article comes to the conclusion that ease of use and usefulness are the two factors that influence adoption.

Overcoming Barriers to Adoption

It is important to understand the source of resistance to innovation in order to appropriately deal with it. Talke and Heidenreich (2014) describe two kinds of resistance to innovation: passive innovation resistance and active innovation resistance. Passive resistance depends on adopter characteristics and situational factors and does not involve having actually tried the innovation. Active innovation resistance is a negative change of

attitude as a result of an unfavourable evaluation when testing a product or service. A number of interventions are used to deal with the barriers to intervention described.

Auster and Ruebottom (2013) recognized that overcoming barriers to adoption often depends on influence, and created five steps to overcoming these barriers: mapping the political landscape, identifying the key influencers for each group of stakeholders, assessing the receptivity of the influencers to the particular innovation, mobilizing the influential promoters and sponsors, and engaging the influential skeptics. The value of this approach is that it ensures that those participating in the process of influencing are the best individuals to accomplish the task. Bacow, et al. (2012) recommended several tactics for addressing barriers: Generous technical support, to help faculty, especially veterans, to be comfortable with the new innovation; faculty incentives, to encourage participation and adoption; making heroes of the faculty pioneers, in order to influence the later adopters; tackling more adaptable academic subjects first, so that the first victories are easy ones, and rewarding the departments using technology with some of the revenue from the course offering.

In addition, professional development can be designed taking into account cultural and political elements of change (Orlando, 2014). Preparing people ahead of time to deal with the various elements of innovation is wise and makes adoption more comfortable.

Change Fatigue

Change fatigue is defined by Bernerth, Walker, and Harris (2011) as "a perception that too much change is taking place" (p. 322). Synonyms include being tired of change, future shock, innovation fatigue, and adaptive failure (Dilkes, Cunningham, & Gray,

2014). It does not require negative change experiences, but takes place even where most people are welcoming of new programs and systems (Michalak, 2012). Educational faculty operate in an environment where continual change is the norm, and often seen as best practice. For K-12 teachers in Australia, particularly, years of rapid, continuous curriculum change led all kinds of teachers to experience change fatigue (Dilkes, et al., 2014). Changes in leadership, organizational structure and curriculum are all common, and lead to change fatigue (Caines, 2013). In the higher educational sector as a whole, there is a high degree of change fatigue (McNeill, Arthur, Breyer, Huber, & Parker, 2012).

Winter (2013) recognizes the high human cost of change fatigue, realizing that those with low change resilience experience the physical signs of stress and the resultant collateral damage it brings. Winter (2013) encourages specific interventions to increase resilience: effective communication, appropriate leadership, support for the change actions, and engagement and fun to build trust.

Bernerth, et al. (2011) portray change fatigue as a negative experience because it is positively associated with exhaustion, which is negatively correlated with organizational commitment. This leads to the intention to leave the organization.

Change fatigue is mentioned in the literature as a factor contributing to the complexity of implementing learning technologies (Uys, 2010). McNeill, et al. (2012) speak of the need to build a high level of academic engagement, which is difficult because of the high degree of change fatigue within the higher education sector. A great number of policy driven changes, such as those experienced at the author's university,

can produce change fatigue in higher education especially if faculty don't see the big picture of tangible change (Smith, 2011).

Aspects of Organizational Change

Successful Organizational Change

Carter (2008) looked at the model Kurt Lewin originated, in which the organization needs first to unfreeze its members by convincing them of the need for change. After the change, refreezing is necessary to ensure that the organization's new course is reinforced by its procedures and practices.

Carter also indicated that an important part of successful change is the skills transfer to those affected by the change. The development of skills ensures that acceptance of the change comes more easily. Carter also created a seven-step model: "set up for success, create urgency, shape the future, implement, support the shift, sustain momentum, and stabilize the environment" (Carter, 2008, p. 23).

Organizational learning is critical for success in higher education organizational change. The kinds of change involved with the change of an operating system is a transformational kind of change, requiring that the innovation be brought into the institution's boundaries and aligned with its culture in order to be successful (Boyce, 2003). Tools such as inquiry, dialogue, and action learning can be helpful in creating a culture of learning within an organization that will facilitate change.

Managing Uncertainty in Change

Allen, Jimmieson, Bordia, and Irmer (2007) conducted two studies to evaluate the relationship between uncertainty and change. Their qualitative research discovered that a

variety of communication sources best helps with change-related uncertainty. Workers appreciate hearing from their direct supervisors how the change will be implemented and how it will affect their jobs. As far as the strategic elements of the change, senior management is seen as the most appropriate source for information to ensure that uncertainty is managed well.

Further quantitative research revealed that a perception of quality change communication resulted in greater openness on the part of employees toward the change. This openness is because of the level of trust produced by the perception of good information. Lines, Selart, Espedal, and Johansen (2005) provide deeper insight into this area of trust. Organizational change can impact the degree of trust in the management of the organization, depending on how employees evaluate trust-relevant factors related to the change.

<center>Trust and Change</center>

Lines, et al. (2005) looked at the relationship between trust and organizational change. In their model, trust is the by-product of identification, competence, fairness, and openness, all moderated by tenure. Tenure indicates that the longer someone has experienced leaders, the more complex their relationship to the leaders are, and the more elements must change in order to change the nature of the trust relationship. Trust becomes very important when organizations are bringing about change. Employees determine, based on trust-relevant experiences, the direction and magnitude of changes in the trust they feel toward organizational management. When change creates unpleasant degrees of stress, trust is likely to fall. When employee participation in the change process is high, trust increases.

An evaluation of social accounts shows that when ideological accounts (a perceived understanding of why the change is necessary) are present, trust increases. Referential accounts (showing how others have succeeded with the change) reduce the level of trust. An interesting finding in the study is that how the change affects the workers' perception of their job characteristics doesn't have much to do with the development of trust during organizational change.

<div style="text-align:center">Sustaining Change</div>

Covington (2002) identified eight steps that would ensure sustainable change. The eight steps include inspiring urgency, joining forces, crafting a vision, infusing the vision through the use of questions, implementing an action plan, ensuring quick victories, exhibiting perseverance, and integrating the change into the culture. These eight steps expand the unfreezing, changing, and refreezing elements introduced by Kurt Lewin, focusing on the importance of preparation and the critical nature of ensuring that the change becomes a part of how the organization operates going forward. Carter (2008) recognized that in order for change to be sustained, employees had to be given the tools to deal with the problems caused by the change.

Sustaining change involves dealing with resistance. Bovey and Hede (2001) evaluated defense mechanisms and resistance to change. Their study discovered that those who are more inclined to exhibit defense mechanisms are also more inclined to resist change. Those who use humor to deal with organizational change's negative factors are less likely to resist change. Those who tended to project their negative feelings onto others were seen as the most likely to resist change. In order to successfully sustain change, it is important to understand the individuals and their specific reasons for

responding to change the way that they do. Understanding these reasons will enable leaders to address concerns appropriately.

Change in Higher Education

In a case study, Bottomley, Spratt, and Rice (1999) evaluated organizational change in higher education. Deakin University sought to bring about changes through its online teaching, learning, and enhancement project using both top-down and ground-up strategies. They realized that academics are more focused on pedagogy than technology, and want to teach using methods that they have mastered. Deakin chose to embed professional development activities into the day-to-day work of academics. Bottomley et al discovered that leadership support is critical for success in the move toward online teaching and learning. In addition, the use of program development teams using a clear project management framework was defined as necessary.

Their study discovered that it is important to create an environment where safe adoption can take place. This requires a spirit of negotiation between the administration and its academics. A safe environment would recognize the career priorities of academics and account for them in the process of adoption.

Samarawickrema and Stacey (2007) covered the implementation of what is now known as *Blackboard Vista* at Monash University in Australia. In this case, 22 academics adopted the LMS. Faculty adopted primarily because they perceived the relative advantage of the adoption and because the adoption was compatible with their existing values. The strongest individual reasons for adoption were the directives from administration, student demand, and pedagogical communication opportunities. Staff were sensitive to the additional workload of teaching with technology and developing

learning resources appropriate to LMSs. There were also concerns over intellectual property issues, as issues of copyright regarding web-based learning materials had not been resolved. Samarawickrema and Stacey concluded that technology adoption had more to do with the motivation, attitudes, and ability to handle new processes of instructors than with their actual technology skills.

Summary

This chapter began by defining and examining the functions of LMSs, tracing their history from one-way information flow systems to dynamic multi-creator system. LMSs are important for institutions because of their significant initial and ongoing cost, and the benefits for student learning and faculty classroom management. The options available for institutions to consider were discussed, both commercial and Open Source, and understood the nature of the industry as exceptionally competitive. LMSs were determined to be very complex, with many levels and many modules.

The topics of affordances and appropriation were explored. Affordances teach us that the benefits of a technology's features depend upon the relationship between the faculty member and the feature. It is important to ensure that faculty members are made aware of the affordances of the technology so that they can choose to Appropriation is the act of the faculty member in recognizing the affordances and choosing to internalize the technology into their social context as they use it. It is important to understand what attractors and repellents exist with LMSs in relation to faculty.

Looking at innovation, many different models were considered, which dealt with various factors that promote adoption. Coskuncay and Ozkan identified elements of application self-efficacy, subjective norm and technological complexity as determinants

of Davis's TAM (Perceived Usefulness and Perceived Ease of Use). Atsoglou and Jimoyiannis looked at facilitating conditions and teachers' self-efficacy. Wejnert identified educational institution, technological familiarity, level of status, socioeconomic characteristics, position in social networks, and personal characteristics as determinants of adoption. Venkatesh and Bagozzi introduced the TAM 2, TAM 3, and TUADMC models, focusing on different determinants. It is interesting to notice that the theories are not necessarily converging down to a common set of factors and that some of the older theories continue to be used in studies even though there are more recently developed ones.

In the process of organizational change, the importance of understanding contextual factors was considered – those outside of the decision-making process of the individual actor. The directives from administration and the demands of students impact adoption strongly. It is important to ensure that the information technology staff are qualified and ready to manage the new system and the training needs. Key elements for successful implementation include instructor involvement, adequate training, and a sufficient guarantee of server uptime (Berking & Gallagher, 2013).

Economic growth comes from wide adoption of innovations; many theories influence the adoption of innovation. The theory of industrial innovation indicates that innovations go through a life cycle from birth through growth, maturity, and decline. Willingness to innovate depends on the stage an innovation is in its life cycle. A factor known as absorptive capacity influences an organization's ability to appreciate and assimilate new information.

Factors affecting innovation decisions include Attitude Toward Using the given innovation, Subjective Norm, and Perceived Behavioral Control, as proposed by Ajzen, Bagozzi, Davis, and Warshaw (1992) suggested through their Theory of Trying that learning can get in the way of adoption and that trial is the appropriate way. Laukkanen, et al. (2007) focused on age as a factor in innovation, recognizing that risk and image are particularly salient factors. Brown, Massey, Montoya-Weiss, and Burkman (2002) looked at mandatory vs. voluntary use situations and recognized that usefulness of technology is most important. If it is absent, there will be no adoption in voluntary situations, and there will be some form of resistance in the mandatory cases. Venkatesh formulated the UTAUT theory, accounting for 70% of variance in usage intention. Seligman (2006) used the sensemaking approach for deeper understanding of the adoption process. Slowikowski and Jarratt (1997) evaluated how culture influences adoption. Mishra, Akman, and Mishra (2014) verified that behavioral intention does impact actual behavior. Kozma found that faculty members were most influenced in innovation decisions by the successes and failures experienced by other faculty members. Together these lessons teach us much about the factors that impact innovation and remind us that rarely does one theory contain all elements that impact whether or not a faculty member will choose to adopt an innovation.

Several barriers to innovation were explored. Aggarwal, Cha, and Wilemon (1998) identified "really new products" and suggested that surrogate buyers be used to help individuals manage the risk of new innovations. Resistance was seen to come from a shaky political climate and low feelings of self-efficacy among faculty. Other barriers were identified including lower comparative utility with respect to the previous system,

increased complexity, and difficulty of access. Change fatigue was also raised as an issue hindering adoption.

Successful organizational change was seen to come through the elements of Lewin's three-step model (1951) as well as Carter's seven-step model (2008), both focusing on the need to unfreeze the present situation and to stabilize the new situation. The importance of a culture of organizational learning was emphasized to ensure that the institution is ready for change. Effective communication and trust in leadership were also expressed as key elements for organizational change.

The study concluded with a reminder of how change operates in higher education, realizing that academics are more interested in pedagogy, the teaching methods, than in the technology that might facilitate the teaching. As such, communications related to the affordances of learning management technologies need to emphasize how the technology will match the teaching approaches of faculty members. To ensure success in the classroom, professional development with the new system and a safe environment where "failure" is acceptable are also necessary. Faculty members will often be comparing the experience of the new system with the experience of the previous system and evaluating the relative advantage and the degree of compatibility with values.

Evaluating the degree of faculty intention to adopt a new LMS is a complex activity, requiring understanding of LMSs, the characteristics of faculty members, the theory of adoption, and the principles of change management. This literature review has examined the literature in each of these areas in preparation for the present study.

CHAPTER 3

METHODOLOGY

Description of the Participants

Faculty members from nine Adventist institutions of higher learning were invited to participate in this study. This included Andrews University, Burman University, La Sierra University, Loma Linda University, Pacific Union College, Southern Adventist University, Southwestern Adventist University, Union College, and Washington Adventist University. Full-time salaried faculty members who use LMSs were invited to be part of the sample.

For each of the nine institutions, full-time salaried faculty members were randomly selected using lists generated from their web pages. Because the student-instructor ratio at each institution was different, the number of students (rather than the number of faculty) at each institution was used to allocate the number of participants. The calculated number of faculty members at the nine institutions was 2000. The target number of participants was set at 200 – approximately 10% of the total full-time faculty members at the nine institutions. This number of participants yielded a margin of error of approximately 6.56%. To ensure that 200 actually participated, 323 faculty members were randomly selected, again roughly according to the proportion of students at each institution. Due to the decentralization of research permissions at Loma Linda University, where each School handles its own permission granting, rather than the institution as a

whole, the number of participants from Loma Linda was less than desired. The

proportion of pool and participants are reflected in Table 1.

Table 1

Participant Distribution Across Institutions

School	Pool	Participants
AU	70	47
Burman	10	10
LSU	48	30
LLU	27	7
PUC	36	20
SAU	54	42
SWAU	32	21
UC	17	7
WAU	29	16
Total	323	200

Data Collection Procedures

To begin the survey collection process, an introductory email was forwarded to

the faculty members, inviting them to click on the link that took them to the

questionnaire. The researcher consistently used the SurveyMonkey email reminder

feature, reminding approximately every other day, and telephoned respondents to

personally remind, until sufficient responses were achieved. Customized surveys were

sent to participants from each university, using their LMS name and university name in

the survey, as appropriate. Where warranted, additional individuals were selected and

added to the pool to generate sufficient successful responses. SurveyMonkey allowed for

raw data to be exported into Excel, which was then formatted, easily evaluated, and

exported into SPSS for statistical analysis.

The Design of the Study

This research study was an empirical, non-experimental, descriptive and confirmatory quantitative study, using survey methods to test and build on the TAM3 within the context of a sample of North American Adventist university faculty. A correlational/cross-sectional design was employed for this study. This design allowed one-time data collection, and enabled a number of comparisons of relevant variables across different universities, different learning managements, genders, and age groups. Using bivariate correlations, partial correlations, and multiple regression analysis, the fit of the overall model between actual results and the hypothesized outcomes was made possible.

The Technology Acceptance Model 3 was used as the foundation model of this study. This model been shown in past studies (Al-Gahtani, 2014; Venkatesh & Bala, 2008) to explain a good deal of the variance of Behavioral Intention and Use Behavior in several settings and applications. The important link between Behavioral Intention and Use Behavior has been established in the literature, with the simple TAM model accounting for 64% of the variance in usage in one study (Chuan-Chuan Lin & Lu, 2000).

Construct Definitions

Behavioral Intention: The degree to which a person has formulated conscious plans to perform or not perform some specified future behavior (Venkatesh & Bala, 2008).

Computer Anxiety: The degree of an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers (Venkatesh & Bala, 2008).

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Computer Playfulness: The degree of cognitive spontaneity in microcomputer interactions(Venkatesh & Bala, 2008).

Computer Self-Efficacy: The degree to which an individual believes that she has the ability to perform specific tasks/jobs using computers (Venkatesh & Bala, 2008)..

Image: The degree to which use of an innovation is perceived to enhance one's status in one's social system (Venkatesh & Bala, 2008).

Job Relevance: An individual's perception regarding the degree to which the target system is relevant to his or her job (Venkatesh & Bala, 2008).

Objective Usability: A comparison of systems based on the actual level (rather than perceptions) of effort required to complete specific tasks (Venkatesh & Bala, 2008).

Output Quality: The degree to which an individual believes that the system performs his or her job tasks well (Venkatesh & Bala, 2008).

Perceived Ease of Use: The degree of ease associated with the use of the system (Venkatesh & Bala, 2008).

Perceived Enjoyment: The degree to which an activity of using a system is perceived to be enjoyable, apart from the performance consequences of system use (Venkatesh & Bala, 2008).

Perceived Usefulness: The degree to which an individual believes that using a system will help him/her to attain job performance gains (Venkatesh & Bala, 2008).

Perceptions of External Control: The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system(Venkatesh & Bala, 2008).

Result Demonstrability: Tangibility of the results of using the innovation (Venkatesh & Bala, 2008).

Subjective Norm: A person's perception that most people who are important to him/her think he/she should or should not perform the behavior in question (Venkatesh & Bala, 2008).

Voluntariness: The extent to which potential adopters perceive the adoption decision to be non-mandatory (Venkatesh & Bala, 2008).

Use Behavior: The daily amount of time spent on the LMS, on average (Venkatesh & Bala, 2008). The usage of a broad array of LMS features.

This construct will be calculated using the self-reporting of faculty members in terms of how they use, and how often they use, the various elements of the LMS.

Added Constructs

Two additional constructs were added to the TAM 3 for testing: Overload and Change Fatigue. These two constructs, uncovered during the literature review search, struck the researcher as interesting subjects to explore. Overload is something faculty members have the potential to experience, with multiple demands of teaching, research, service, and committee work placed on their shoulders. The inclusion of Change Fatigue was also inspired by a realization of the tremendous number of changes experienced by personnel at the researcher's university.

Change Fatigue: Passive resignation, general apathy regarding change, being unable to defend the current state nor move toward the desired future (Turner, 2012) occurs when the perception by the individual is that many changes have been undergone, with the results of those changes often perceived to be unsuccessful (McElroy, 1996).

Change Fatigue results in "malaise, frustration and cynicism" (Ace & Parker, 2010, p. 21).

Initiative Overload is the "tendency of organizations to launch more changes than anyone could ever reasonably handle" (Abrahamson, 2004). Change Overload is the experience of individuals in a situation where they have to deal with more changes than they are personally comfortable with. This construct is measured using a seven-point Likert scale.

Both of these constructs are designed to have a direct influence on Behavioral Intention. Change Fatigue's impact on an individual directly affects his or her willingness to change (Verhage, 2010). Overload is hypothesized to directly affect Behavioral Intention.

Statement of Hypotheses

Hypothesis 1. Subjective Norm is positively and directly correlated with Image.

Hypothesis 2. Perceived Usefulness is directly and positively correlated with Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability.

Hypothesis 3A. Perceived Ease of Use is directly and positively correlated with Computer Self-Efficacy, Perceptions of External Control, Computer Playfulness, Perceived Enjoyment, and Objective Usability.

Hypothesis 3B. Perceived Ease of Use is directly and negatively correlated with Computer Anxiety.

Hypothesis 4. Perceived Usefulness is directly and positively correlated with Perceived Ease of Use.

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Hypothesis 5. The relationship between Perceived Usefulness and Subjective Norm is mediated by Experience.

Hypothesis 6. Behavioral Intention is directly and positively correlated with Perceived Ease of Use.

Hypothesis 7. Behavioral Intention is directly and positively correlated with Perceived Usefulness.

Hypothesis 8. Behavioral Intention is directly and positively correlated with Subjective Norm.

Hypothesis 9. The influence on Behavioral Intention of Subjective Norm is mediated by Experience.

Hypothesis 10. The influence on Behavioral Intention of Subjective Norm is mediated by Voluntariness.

Hypothesis 11. New to the model, Overload is directly and negatively correlated with Behavioral Intention.

Hypothesis 12. New to the model, Change Fatigue is directly and negatively correlated with Behavioral Intention.

Hypothesis 13. Use Behavior is directly and positively correlated with Behavioral Intention.

The Variable List

Below, the four central components of the TAM 3 and the two mediating variables are described in a general sense. The questions that measure each variable are described later in the dissertation.

1. Behavioral Intention. The degree of intention to integrate the university's

Learning Management System into any aspect of teaching classes at the university

(dependent variable): Refers to the degree to which faculty members intend to use the

various elements of an LMS in their teaching practice. This was measured with a seven-

point Likert scale using faculty self-reporting.

2. Use Behavior. The perceived adoption of the university's Learning

Management System using aspects of the LMS in teaching classes at the university

(dependent variable): Refers to the degree to which faculty members use the various

elements of an LMS in their teaching practice. This was measured using nine questions

on the survey questionnaire.

3. Perceived usefulness (independent variable): Refers to aspects of faculty

members that influence their intention to integrate. Perceived Usefulness is determined

by Subjective Norm (moderated by Experience), Image, Job Relevance, Output Quality,

and Result Demonstrability. These were measured through a seven-point Likert scale

from "strongly disagree" to "strongly agree."

4. Perceived ease of use (independent variable): Refers to a faculty characteristic

self-report of the faculty member's perception of the system's nature, determined by

Computer Self-Efficacy, Perceptions of External Control, Computer Anxiety, Computer

Playfulness, Perceived Enjoyment, and Objective Usability. This was calculated using a

seven-point Likert scale from "strongly disagree" to "strongly agree."

5. The mediating variables Experience and Voluntariness. For the variables

Experience and Voluntariness, to determine whether the variable Subjective Norm has a

greater direct or mediated influence, path analysis was used to calculate the mediated influence of Experience between Subjective Norm and Behavioral Intention.

Justification for Model

A review of the literature found that that there were many models that could be used to explain the responses of individuals to innovation. Each model has strengths and weaknesses when it comes to use in a study such as this one. The UTAUT model has a very high r-squared, but it is very complex. Three determinants influence Behavioral Intention, which influences Use Behavior. One determinant directly influences Use Behavior. Between two and four modifying elements touch each of the four arrows between the aforementioned determinants. This complexity would require an inordinately long survey in order to test all of the interactions between elements.

The TAM model is widely used in the literature, with 34,478 citations for the original articles introducing TAM and TAM 2 in Google Scholar. Its construction over time has been logical and increasingly useful. The original model's determinants were perceived usefulness and perceived ease of use, and the successive models began to develop the determinants for these factors and the interactions between them. TAM began as a compact core, and over time, determinants that were demonstrated to have influence were added to form the TAM 3.

The TAM 3 model is specifically designed for computer innovations, which LMSs are, and the dimensions measured are quite comprehensive. Having examined several alternative approaches to examining innovations (TRA, UTAUT, Wejnert) this is believed to be the most appropriate model for this study.
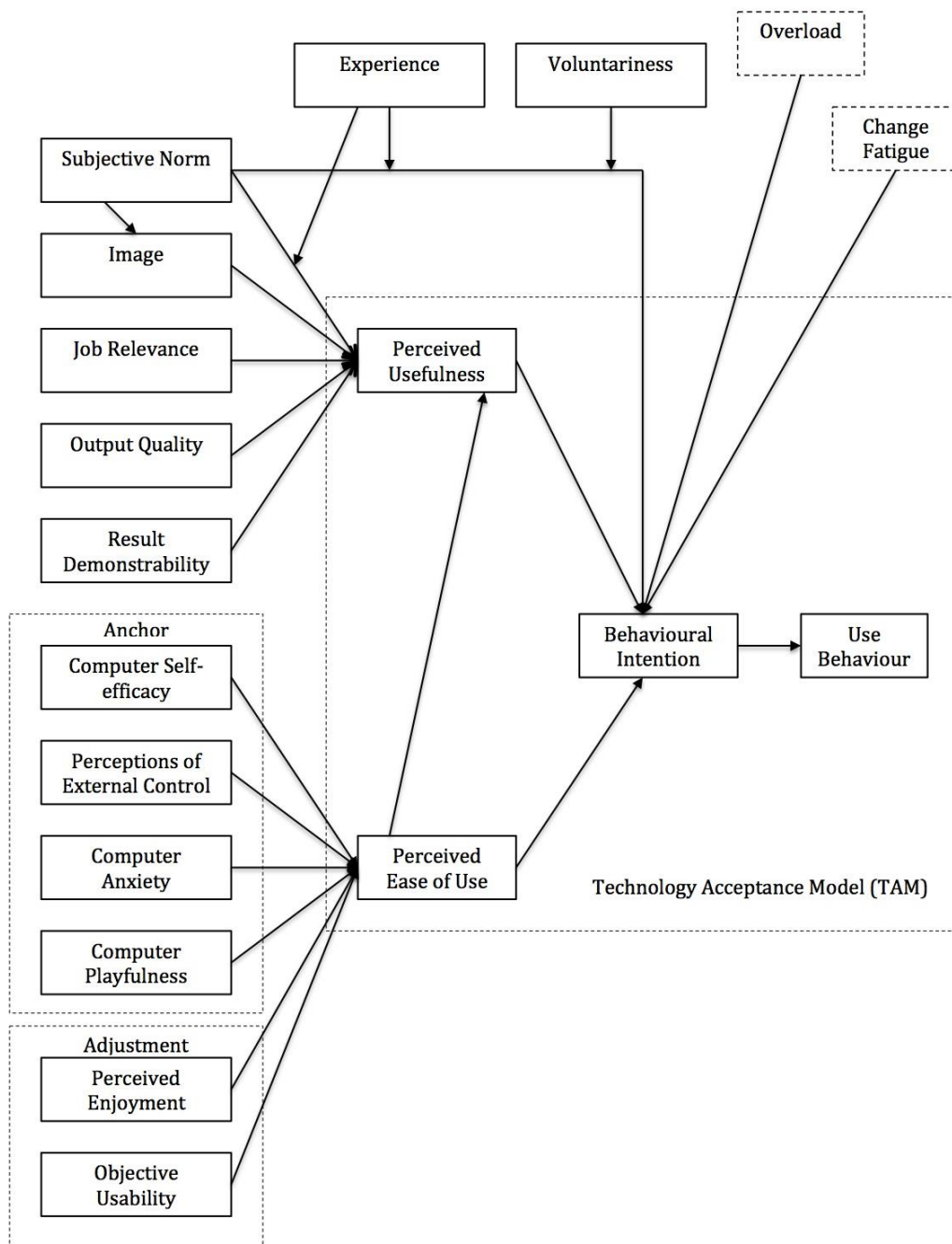
Figure 2. Revised Technology Acceptance Model 3

The Instrument

The online survey instrument includes 35 content questions and 5 demographic questions. First, some clarification:

All questions used in the measurement of variables in the study for the TAM 3 model were adapted from Venkatesh and Bala (2008). The questions about Change Fatigue were adapted from (Bernerth, et al., 2011). The Overload questions were based on the definition of Overload. All questions were assessed with a 7-point Likert scale with anchors of 1 *(strongly disagree),* 2 *(moderately disagree),* 3 *(somewhat disagree),* 4 *(neutral),* 5 *(somewhat agree),* 6 *(moderately agree)*, and 7 *(strongly agree).* Many variables were measured with a single question. There were several, however, where more than one question was required to cover the ground. If more than one question was used, the final value was the mean of the questions asked.

Different LMSs were employed at different universities. The present study did not seek to address the effectiveness of different systems, but rather faculty compliance, identification, or internalization with use of those systems (Venkatesh & Bala, 2008). Satisfaction was also measured. When the term "[the LMS]" was used, for each university, the LMS currently in use at that university was inserted.

There were also demographic questions that assessed gender, ethnicity (White, Black, Asian, Hispanic, Other), number of years at current university, and total number of years teaching. The idea of using "age" was discarded since some may consider such a question intrusive; the total number of years teaching was felt to provide a reasonable estimate. To determine whether Adventist vs. non-Adventist education made a difference,

a final demographic question asked for the university of the respondent's highest degree. The questions now follow – starting with the central dependent variable, Use Behavior.

1. Use Behavior 1. I use [the LMS] to integrate sharing of content and/or class documents into my class.

2. Use Behavior 2. I use [the LMS] to integrate the use of the calendar function into my class instruction and course management.

3. Use Behavior 3. I use [the LMS] to integrate the use of the grade book into my class instruction and course management?

4. Use Behavior 4. I use [the LMS] to integrate the use of the quiz tool into my class instruction and course management?

5. Use Behavior 5. I use [the LMS] to integrate the use of the test administration function into my class instruction and course management?

6. Use Behavior 6. I use [the LMS] to integrate the use of message boards into my class instruction and course management?

7. Use Behavior 7. I use [the LMS] to integrate the use of announcements into my class instruction and course management?

8. Use Behavior 8. I use [the LMS] to integrate the use of the dropbox/assignment area into my class instruction and course management?

9. Perceived Usefulness 1. Using [the LMS] at [university] increases my job-related productivity and effectiveness.

10. Perceived Usefulness 2. Using [the LMS] at [university] increases my job-related effectiveness.

11. Perceived Ease of Use. I find [the LMS] at [university] clear and understandable.

12. Computer Self-Efficacy. I am fluent in the use of a computer.

13. Computer Self-Efficacy 2. I can figure out almost any software program with a minimum of effort.

14. Perceptions of External Control. I am confident in my ability to control [the LMS].

15. Computer Playfulness. I like to be creative and have fun when using computers.

16. Computer Anxiety. I get dysfunctionally nervous when working with a computer.

17. Perceived Enjoyment. I enjoy myself when using [the LMS].

18. Objective Usability. Task: Open your LMS. From the main screen of any course, time how long it takes for you to create a news/announcement item with the title "Test Announcement" and the text "Technology is fun!" Responses: 1. 0 - 9 seconds, 2. 10-19 seconds, 3. 20-29 seconds, 4. 30-39 seconds, 5. 40-49 seconds, 6. 50-59 seconds, 7. 1 minute or more.

19. Subjective Norm 1. My colleagues think I should use [the LMS]

20. Subjective Norm 2. The administration urges us to use [the LMS]

21. Voluntariness 1. It is my choice whether I use [the LMS] at [university].

22. Voluntariness 2. I am given the freedom to choose whether or not I use [the LMS] at [university].

23. Image. Administrations and colleagues at [university] will think highly of me if I use [the LMS].

24. Job Relevance. The use of [the LMS] is pertinent to my job-related tasks.

25. Output Quality. I consider the output of [the LMS] to be excellent.

26. Result Demonstrability. I believe I would have no problem explaining to someone else the benefits of using the various features of [the LMS].

27. Behavioral Intention. I intend to make good use of [the LMS] [university] has provided.

28. Change Fatigue 1. The people at [university] who are responsible for solving problems don't try hard enough to solve them.

29. Change Fatigue 2. I am tired of all of the changes in Learning Management Systems at [university].

30. Overload 1. I feel burdened with too many tasks and responsibilities at [university].

31. Overload 2. I often feel exhausted and/or that my efforts are useless because of my work at [university].

32. Use 1. On average, how much time do you spend on [the LMS] each day? 1. (*none*), 2 (*1-5 min), 3 (6-15 min*), 4 (*16-30 min*), 5 (*31-59 min*), 6 (*1-2 hours*), 7 (*> 2 hours*)

33. Use 2. Does an assistant use [the LMS] on your behalf? The original Likert scale is used for the final three questions.

34. Present Satisfaction. I am satisfied with the present LMS at [university].

35. Future Desire. I would welcome a different LMS at [university].

The demographic questions inquired as to the gender, ethnicity, years serving at present university, years teaching total, and university of highest degree.

Form of Analysis

During the data collection process, each returned form was scrutinized to determine its validity and acceptability for use. Forms were examined to see if they were complete, and if there were any apparent abnormalities in the responses. If not, the form was discarded and an additional randomly selected individual was contacted to participate. This guaranteed the desired N of 200 randomly selected participants from the nine universities.

Initial analysis determined the psychometric validity of variables. Based on past experience with this type of survey it was likely that all variables would have acceptable skewness and kurtosis values for continued analysis. If an important variable was not approximately normally distributed, then a natural-log was employed to ensure its usability in further analyses.

To test the overall model, bivariate correlations were computed between each predictor variable and its criterion variable, as indicated in Figure 2. For instance, a correlation was computed between Subjective Norm and Perceived Usefulness – a direct link. Other examples of direct links included the links between Image and Perceived Usefulness, between Result Demonstrability and Perceived Usefulness, between Computer Self-Efficacy and Perceived Ease of Use, and between Perceived Ease of Use and Behavioral Intention. The correlation was not calculated between Image and Behavioral Intention, for example, since there was no direct link between the two variables in the TAM 3 model.

Path analysis was conducted in instances where there was a possible mediated influence of one or more variables. For instance, Venkatesh and Bala's TAM 3 model shows a link between Subjective Norm and Perceived Usefulness, but also shows the possible mediating influence of Experience. To calculate this, a multiple regression was conducted with Subjective Norm and Experience as the predictor variables and with Perceived Usefulness as the dependent variable. Next, bivariate correlations were calculated between the three variables. This information identified whether the direct link between Subjective Norm and Perceived Usefulness was greater or whether the Experience variable added significantly to explain the variance in Perceived Usefulness.

The influence of certain demographics and other variables was computed. One-way ANOVAs determined if there were differences between Universities, between different LMSs, between genders, and between ethnic groups. Finally, correlations determined whether the total number of years teaching had a significant influence on the relevant central variables (Use Behavior, Behavioral Intention, Perceived Ease of Use, Perceived Usefulness).

Validity and Reliability

The TAM 3 model is a tested theoretical framework that can be counted on in evaluating determinants of intention to use and use behavior in e-learning contexts. To ensure validity, survey questions used were sourced and adapted from other similar instruments: the TAM 3 construct items (Venkatesh & Bala, 2008), the Change Fatigue source items (Bernerth, et al., 2011), and the definition of Overload.

Summary of Methodology

This chapter presented details regarding the methodology and research design of this study. This study used a researcher-designed survey using subjective data to gather information about the attitudes of faculty members toward the implementation of LMSs and the factors believed to influence said attitudes, in the context of nine North-American Seventh-day Adventist universities and colleges. Bivariate analysis and path analysis were used to analyze the various hypotheses and to determine the degree of relationship between intention to implement and use LMSs and the determinants of the Technology Acceptance Model 3.

CHAPTER 4

RESULTS

This chapter communicates the results of this study. Descriptive statistics are reported for all variables, as well as findings with regard to demographics, psychometrics, and differences between groups. Using correlations, regressions, and path analysis, the components of the Technology Acceptance Model 3 are examined and hypotheses are assessed, leading to a revised proposed model of significant links.

Demographics

The study randomly selected a total of 323 participants from nine Seventh-day Adventist universities located in the United States and Canada. Four of the thirteen Adventist institutions were unavailable for participation. The goal for data collection was a final N of 200—a number providing sufficient statistical power to yield valid and useful inferences. Potential participants were selected from each university approximately proportional to their undergraduate enrolment. Undergraduate enrolment was used to level the playing field among the participating universities, as some do not have graduate schools. The reason more than 200 were selected was that it was correctly anticipated that all potential participants would not be able and willing to participate. So, while the initial 323 were randomly selected, the final N was comprised of participants from those 323

willing to participate. Undergraduate student enrolment numbers were used to level the playing field among the participating universities.

The 200 participants included 63% Caucasian, 11% African American, 6% Hispanic, 6.5% Asian, and 13.5% mixed or other. Gender breakdown showed 119 men and 81 women. The number of participants from each university included 47 from Andrews University, ten from Burman University, 30 from La Sierra University, seven from Loma Linda University, 20 from Pacific Union College, 42 from Southern Adventist University, 21 from Southwestern Adventist University, seven from Union College, and 16 from Washington Adventist University.

Table 2 below shows the frequencies, percentages and which LMS was used at each university.

Table 2

Frequency, Percentage, and LMSs Used at Nine North American Seventh-day Adventist Universities

	Frequency	Percent	LMS
Andrews	47	23.5	Moodle
Burman	10	5.0	D2L
La Sierra	30	15.0	Blackboard
Loma Linda	7	3.5	Canvas
PUC	20	10.0	Canvas
SAU	42	21.0	Moodle
Southwestern	21	10.5	D2L
Union	7	3.5	Moodle
WAU	16	8.0	D2L
Total	200	100.0	

Frequency represents the number of faculty in the sample. Percent is the percentage of the sample of 200.

Table 3 shows that four different LMSs were used at the nine universities. The number of participants from universities that used a common Learning Management System was aggregated for this table. Ninety-six participants (48% of all participants) were from a university using *Moodle*. Forty-seven participants (23.5%) were from a university using *Desire2Learn*. Thirty participants (15%) were from a university using *Blackboard*, and 27 participants (13.5%) were from a university using *Canvas*.

Table 3

Distribution of North American Adventist Faculty Users Among Four LMSs

	Users	Percent
Moodle	96	48.0
D2L	47	23.5
Blackboard	30	15.0
Canvas	27	13.5
Total	200	100.0

Length of time teaching by each of the participants had a mean of 15.88 years with a standard deviation of 9.52 and a range of one to 42 years. Length of time teaching at their current university was a mean of 12.38 years with a standard deviation of 8.59, and range of one to 42 years.

The university from which participants received their highest degree included 39 Seventh-day Adventist universities, and 138 public universities. Twenty-three participants did not respond to this question.

Psychometrics

A measure of internal consistency of multiple indicator variables was calculated. Only one of the multiple-indicator variables (the dependent variable, Use Behavior) had more than two questions determining that measure. The other seven predictors had only two questions each that created the variable used in the model. A small N consistently diminishes the alpha value, so the actual alphas are not typically used to eliminate the use of a predictor. That said, of the eight measures three showed excellent internal validity: Use Behavior ($N = 9$, $\alpha = .88$), Voluntariness ($N = 2$, $\alpha = .94$), and Perceived Usefulness ($N = 2$, $\alpha = .95$). Three others showed good internal validity: Computer Self-Efficacy ($N = 2$, $\alpha = .79$), Satisfaction ($N = 2$, $\alpha = .77$), and Overload ($N = 2$, $\alpha = .77$). Two variables showed fair internal consistency: Change Fatigue ($N = 2$, $\alpha = .55$), and Subjective Norm ($N = 2$, $\alpha = .52$).

The two variables with low alpha are considered: Subjective Norm was based on a) the perception of colleagues' opinions, and b) the perception of administrative desires. The two questions have excellent face validity in that those are the typical sources of social pressure for change of behavior for university faculty members. The fact that the two may influence faculty members to use the LMSs differently from one another does not diminish the importance of both sources.

For Change Fatigue, the two questions used in the present study represent two components commonly used in measures of this type (Ead, 2014; Miller, 2012). One measures level of cynicism and the other measures distress over many changes. Past literature supports the inclusion of both components in a measure of change fatigue and despite the modest alpha value can serve in the present study as a valid variable.

Descriptive statistics for each of the variables used in the model reveal that 17 of the 20 variables show excellent psychometric validity with both skewness and kurtosis values ranging between ±1.0. Two of the other three (Behavioral Intention and Objective Usability) show satisfactory psychometric validity with kurtosis and skewness values only slightly outside the ±1.0 criterion.

Only one of the variables (Computer Anxiety) showed unacceptable psychometrics with a kurtosis value > 3.0. The reason for the distortion is simple enough: few participants registered any computer anxiety. In fact, over 60% of participants responded with "strongly disagree" to the question "I get dysfunctionally nervous when working with a computer." This pattern, of course, produces the problems with skewness and kurtosis evident in the distribution. Taking the natural logarithm of the variable restored psychometric validity with a skewness of 1.035 and a kurtosis of -.193. Lnanxiety was systematically used in analyses that involved Computer Anxiety. The chart that follows shows *N*, mean, standard deviation, skewness, and kurtosis for all variables, rank ordered from highest to lowest mean value.

Table 4

Descriptive Statistics for All Variables

	N	Mean	Std. Dev.	Skewness	Kurtosis
Experience	200	15.88	9.520	.674	-.090
Computer Self-Efficacy	200	5.43	1.450	-.984	.228
Behavioral Intention	200	5.37	1.639	-1.197	.808
Subjective Norm	200	5.32	1.105	-.499	.835
Job Relevance	200	5.13	1.867	-.974	-.011
Perceived Usefulness	200	5.07	1.908	-.929	-.171
Computer Playfulness	200	5.00	1.582	-.654	-.163
Perceptions of Ext. Control	200	4.83	1.785	-.726	-.525
Voluntariness	200	4.59	2.019	-.504	-.983
Satisfaction	200	4.52	1.621	-.410	-.480
Results Demonstrability	200	4.51	1.629	-.614	-.306
Output Quality	200	4.47	1.550	-.664	-.231
Perceived Ease of Use	200	4.40	1.905	-.543	-.944
Image	200	4.39	1.348	-.153	.675
Overload	200	4.35	1.588	-.158	-.684
Perceived Enjoyment	200	4.03	1.633	-.383	-.515
Use Behavior	200	4.00	1.426	-.194	-.787
Objective Usability	200	3.39	2.022	.090	-1.406
Change Fatigue	200	3.12	1.442	.456	-.237
Computer Anxiety	200	1.81	1.305	1.866	3.010
ln of Computer Anxiety	200	.41	.562	1.035	-.193

Unusable Forms and Missing Values

There were 203 total forms completed. All forms were scrutinized to check for unusual patterns of responses or other abnormalities. Eventually only three forms were dropped, in all three cases because they did not answer enough questions to make valid inferences.

For the 200 usable forms 3.4% of the questions were unanswered (e.g. missing values) which falls well within the 15% missing values considered acceptable for valid inference (George & Mallery, 2014). Two methods were used to replace the missing values: predicted values based on regression equations, and the mean value of other participants for a certain question.

Predicted values were used when other questions provided a valid regression equation for predicting particular missing values and all 200 participants could be involved in the creation of the equation. The equations were based on the individual questions, not on the composite questions used in the model. Eight questions used predicted values to replace missing values. The R^2 values were robust for 6 of the 8 equations, ranging from .42 to .75. R^2 values for the other two questions were weak (.18 and .19) but both questions were idiosyncratic: one was the timed test, requiring respondents to enter specific information in the news function of their LMS, and the other sought to determine to what extent an assistant used the LMS for the respondent. Questions and equations are listed in Table 5.

Table 5

How Missing Values Were Replaced

Questions where missing values were replaced with predicted values

15. I like to be creative and have fun when using computers.
Equation:
$Q15_{pred} = 2.04 + .38 (Q13) + .21(Q12) -.13(Q29) - .24(Q11) +.24(Q17) +.07 (Q33); R^2 = .48$

16. I get dysfunctionally nervous when working with a computer.
Equation:
$Q16_{pred} = 3.00 + .51(Q12) + .17(Q13) -.09(Q22) - .14(Q23) +.07(Q8); R^2 = .55$

17. I enjoy myself when using [the LMS].
Equation:
$Q17_{pred} = -.68 + .22(Q11) + .30(Q25) + .19(Q26) + .17(Q10) +.13(Q15); R^2 = .64$

18. Timed task activity
Equation: $Q18_{pred} = -.37 + .35(Q12) + .16(Q7) + .19(Q13); R^2 = .19$

27. I intend to make good use of [the LMS] [my university] has provided.
Equation:
$Q16_{pred} = .91 + .27(Q10) + .12(Q26) + .12(Q34) + .08(Q3) + .13(Q1) + .16(Q17) - .11(Q29) + .11(Q20); R^2 = .75$

32. On average, how much time do you spend on [the LMS] each day?
Equation:
$Q17_{pred} = .21 + .19(Q1) + .22(Q3) + .18(Q7) + .15(Q4); R^2 = .54$

33. Does an assistant use [the LMS] on your behalf?
Equation:
$Q16_{pred} = 4.10 - .16(Q3) + .23(Q15) - .24(Q8) + .28(Q7) +.37(Q25) - .34(Q10); R^2 = .18$

35. I would welcome a different LMS at [university].
Equation:
$Q17_{pred} = 1.21 + .64(Q34) - .10(Q13) + .13(Q19); R^2 = .42$

Table 5 – *Continued*

Questions that are University Specific (Mean of participants at that university)

19. My colleagues think I should use [the LMS]
20. The administration urges us to use [the LMS]
21. It is my choice whether I use [the LMS] at [university]
22. I am given the freedom to choose whether or not I use [the LMS] at [university].
23. I am given the freedom to choose whether or not I use [the LMS] at [university].
28. The people at [university] who are responsible for solving problems don't try hard enough to solve them.
29. I am tired of all of the changes in Learning Management Systems at [university].
30. I feel burdened with too many tasks and responsibilities at [university].
31. I often feel exhausted and/or that my efforts are useless because of my work at [university].
34. I am satisfied with the present LMS at [university]

Questions that are LMS specific (Mean of participants using that LMS)

24. The use of [the LMS] is pertinent to my job-related tasks.
25. I consider the output of [the LMS] to be excellent.
26. I believe I would have no problem explaining to someone else the benefits of using the various features of [the LMS]

The mean values were used when a question related to a particular LMS or a certain university. If a question related to attitudes or procedures at a particular university then the mean value of other participants from that university were used. If a question was associated with attitudes or procedures related to an LMS, than the mean value for all individuals using that LMS was used. Predicted values were not used in these cases because the number of individuals in each subset was not large enough to form a valid equation. Questions used in each of these two conditions are also listed in Table 5 following the regression equations.

Gender Differences

Across the 20 variables used in the research, men and women are noted more for their similarities than their differences. On 17 of the 20 variables they did not differ significantly. For the three variables where significant differences occur, none of the three variables played much of a role in the model being tested. Because of this, the present study used only one model that includes both genders.

The three findings involving differences (means for men, means for women) were that women are more influenced by Subjective Norm (Ms = 5.18, 5.53), t(198) = -2.222, p = .027, are more concerned with their Image (Ms = 4.13, 4.79), t(198) = -3.515, p = .001, and have less Experience (that is, have taught a fewer number of years) (Ms = 17.49, 13.52), t(198) = 2.953, p = .004. Table 6 displays these comparisons.

Table 6

Independent-Samples t test of Gender Differences

	Mean-men	Mean-women	t	df	Sig. (2-tail)
Subjective Norm	5.18	5.53	-2.222	198	.027
Image	4.13	4.79	-3.515	198	.001
Experience	17.49	13.52	2.953	198	.004

Comparisons of Groups: University, Ethnicity, LMS

Nine different Seventh-day Adventist universities were involved in the study. One-way ANOVAs were conducted for the four central variables of the TAM model (Use Behavior, Behavioral Intention, Perceived Usefulness, and Perceived Ease of Use) to see if there were significant differences among the universities. A challenge of attempting ANOVAs with 200 participants divided up into nine different groups is that

the individual *N*s of different universities are often so low that significant differences are difficult to find.

     The One-way ANOVA found that significant effects exist for all four questions (see Table 7 for specifics). Because of difficulties with statistical power due to low *N*s in some groups, both a conservative test (Bonferroni) and a liberal test (LSD) examined pairwise comparisons.

Table 7

ANOVA Results for Variables Use Behavior, Behavioral Intention, Perceived Usefulness, and Perceived Ease of Use for Nine North American Seventh-day Adventist Universities

		Sum of Squares	df	Mean Square	F	Sig.
Use	Between Groups	58.215	8	7.277	3.082	.003
Behavior	Within Groups	450.995	191	2.361		
	Total	509.210	199			
Behavioral	Between Groups	56.495	8	7.062	2.823	.006
Intention	Within Groups	477.860	191	2.502		
	Total	534.355	199			
Perceived	Between Groups	85.514	8	10.689	3.194	.002
Usefulness	Within Groups	639.141	191	3.346		
	Total	724.655	199			
Perceived	Between Groups	79.547	8	9.943	2.956	.004
Ease of Use	Within Groups	642.453	191	3.364		
	Total	722.000	199			

     For Use Behavior, Loma Linda (*M* = 5.35) used their LMS significantly more than La Sierra (*M* = 3.31). For Behavioral Intention, PUC showed greater intent to use their LMS (6.15) than Burman (3.90). For Perceived Usefulness, PUC viewed their LMS

as more useful ($M = 6.28$) than Burman ($M = 3.55$) and WAU ($M = 4.22$). These were the only significant findings in these comparisons.

Table 8 shows the much more frequent significant effects with pairwise comparisons using the LSD method. LSD may be a more appropriate post hoc method to assist in uncovering undoubtedly significant differences if the N was larger.

Using a One-way ANOVA, there were no significant pairwise differences for the ethnicity of the faculty members for any of the four central variables (Use Behavior, Behavioral Intention, Perceived Usefulness, and Perceived Ease of Use), using the conservative Bonferroni post hoc analysis. When comparing the four LMSs, only the variables Use Behavior, Perceived Usefulness and Perceived Ease of Use are included in the analysis since there is no logical reason that an LMS would substantively influence the intention to use by faculty members. Since there are only four LMSs, the statistical power is sufficient to use the more conservative Bonferroni method for post hoc comparisons.

Canvas was demonstrated to score significantly higher than the other three LMSs for all three of the variables. Table 9 below shows the overall ANOVA results.

Post hoc comparisons using the Bonferroni method with an alpha of .05 found that for Use Behavior, *Canvas* ($M = 5.07$) was used significantly more than *Moodle* ($M = 3.98$), *D2L* ($M = 3.63$) and *Blackboard* ($M = 3.31$). For Perceived Usefulness, *Canvas* ($M = 6.26$) was found to be significantly more useful than *Moodle* ($M = 5.14$), *Blackboard* ($M = 4.63$), and *D2L* ($M = 4.50$). For Perceived Ease of Use, *Canvas* ($M = 5.70$) was found to be significantly easier to use than *Blackboard* ($M = 4.33$), *Moodle* ($M = 4.27$), and *D2L* ($M = 3.96$).

Table 8

Comparison of Significant Differences Between Universities

Variable	University	mean	Compared University	mean	LSD sig.	Bonferroni sig.
Use Behavior	Loma Linda	5.35				
			Andrews	3.90	.021	*ns*
			WAU	3.87	.035	*ns*
			Southwestern	3.71	.015	*ns*
			Union	3.52	.027	*ns*
			La Sierra	3.31	.002	*ns*
			Burman	3.10	.003	*ns*
	PUC	4.97				
			Andrews	3.90	.010	*ns*
			Southwestern	3.71	.010	*ns*
			Union	3.52	.034	*ns*
			La Sierra	3.31	<.001	.009
			Burman	3.10	.002	*ns*
Behavioral Intention	Burman	3.90				
			Andrews	5.13	.027	*ns*
			SAU	5.52	.004	*ns*
			WAU	5.81	.003	*ns*
			Southwestern	5.81	.002	*ns*
			Loma Linda	6.00	.008	*ns*
			PUC	6.15	<.001	.011
	La Sierra	4.83				
			WAU	5.81	.047	*ns*
			Southwestern	5.81	.031	*ns*
			PUC	6.15	.004	*ns*
	Andrews	5.13				
			PUC	6.15	.016	*ns*
Perceived Usefulness	Burman	3.55				
			Andrews	4.93	.032	*ns*
			Southwestern	5.17	.023	*ns*
			SAU	5.43	.026	*ns*
			Loma Linda	6.21	.004	*ns*
			PUC	6.28	<.001	.006
	WAU	4.22				
			SAU	5.43	.026	*ns*

| | | | Loma Linda | 6.21 | .017 | *ns* |
| | | | PUC | 6.28 | .001 | .035 |

Table 8 – *Continued*

Variable	University	mean	Compared University	mean	LSD sig.	Bonferroni sig.
	La Sierra	4.63				
			Loma Linda	6.21	.041	*ns*
			PUC	6.28	.002	*ns*
	Andrews	4.93				
			PUC	6.28	.006	*ns*
Perceived Ease of Use	Loma Linda	6.14				
			SAU	4.60	.040	*ns*
			Southwestern	4.52	.044	*ns*
			La Sierra	4.33	.020	*ns*
			Andrews	4.04	.005	*ns*
			Union	3.86	.021	*ns*
			WAU	3.63	.003	*ns*
			Burman	3.30	.002	*ns*
	PUC	5.55				
			La Sierra	4.33	.023	*ns*
			Andrews	4.04	.002	*ns*
			Union	3.86	.037	*ns*
			WAU	3.63	.002	*ns*
			Burman	3.30	.002	*ns*
	SAU	4.60				
			Burman	3.30	.046	*ns*

Table 9

ANOVA Results for Three Variables for LMSs Used at Nine North American Seventh-day Adventist Universities

		Sum of Squares	df	Mean Square	F	Sig.
Use Behavior	Between Groups	34.112	3	11.371	6.007	.001
	Within Groups	370.998	196	1.893		
	Total	405.110	199			
Perceived Usefulness	Between Groups	59.652	3	19.884	5.860	.001
	Within Groups	665.003	196	3.393		
	Total	724.655	199			
Perceived Ease of Use	Between Groups	56.830	3	18.943	5.582	.001
	Within Groups	665.170	196	3.394		
	Total	722.000	199			

Technology Acceptance Model

Support and Non-Support of Hypotheses

In the thirteen hypotheses proposed, a total of 22 individual statements were proposed. Of these 22, 14 were supported, and eight were not supported. The details can be found in Table 10.

Predictors of Perceived Usefulness

The TAM 3 can be divided into several components. The first component examined was Perceived Usefulness and its derivative components. For tests of significance, the rule of thumb for using one-tailed or two-tailed significance is typically contingent on whether the direction of influence is known. In the present study, while the

Table 10

Summary of Hypothesis Results

#	topic	r	Sig. (2-tail)	Support
1	Subjective Norm positively correlated with Image	.437	<.001	support
2	Perceived Usefulness positively correlated with Subjective Norm	.224	.001	support
	Perceived Usefulness positively correlated with Image	.127	.074	no support
	Perceived Usefulness positively correlated with Job Relevance	.467	<.001	support
	Perceived Usefulness positively correlated with Output Quality	.512	<.001	support
	Perceived Usefulness positively correlated with Result Demonstrability	.563	<.001	support
3A	Perceived Ease of Use positively correlated with Computer-Self-Efficacy	.122	.043	no support
	Perceived Ease of Use positively correlated with Perceptions of External Control	.526	<.001	support
	Perceived Ease of Use positively correlated with Computer Playfulness	.005	.472	no support
	Perceived Ease of Use positively correlated with Perceived Enjoyment	.685	<.001	support
	Perceived Ease of Use positively correlated with Objective Usability	.132	.032	no support
3B	Perceived Ease of Use negatively correlated with Computer Anxiety	-.083	.243	no support
4	Perceived Usefulness positively correlated with Perceived Ease of Use	.705	<.001	support
5	Perceived Usefulness influence on Subjective Norm mediated by Experience	.224/ .219	.001/ .002	no support
6	Behavioral Intention positively correlated with Perceived Ease of Use	.644	<.001	support
7	Behavioral Intention positively correlated with Perceived Usefulness	.740	<.001	support
8	Behavioral Intention positively correlated with Subjective Norm	.270	<.001	support
9	Subjective Norm influence on Behavioral Intention mediated by Experience	.270/ .267	<.001/ <.001	no support
10	Subjective Norm influence on Behavioral Intention mediated by Voluntariness	.270/ .202	<.001/ .004	support
11	Overload negatively correlated with Behavioral Intention	.048	.251	no support
12	Change Fatigue negatively correlated with Behavioral Intention	-.422	<.001	support
13	Use Behavior positively correlated with Behavioral Intention	.646	<.001	support

direction of influence was often anticipated, a two-tailed test was also more conservative providing greater confidence that results were valid. Thus, two-tailed tests were used throughout the study unless otherwise stated.

The correlation between Subjective Norm and Perceived Usefulness was .224 ($p = .001$); between Image and Perceived Usefulness was .127 ($p < .074$); between Job Relevance and Perceived Usefulness .667 ($p < .001$); between Output Quality and Perceived Usefulness .512 ($p < .001$); and between Result Demonstrability and Perceived Usefulness .563 ($p < .001$). One correlation was measured between component variables: the correlation between Subjective Norm and Image was .473 ($p < .001$). A stepwise multiple regression was performed on these variables with a criterion variable of Perceived Usefulness and the other five variables as predictors.

No significance was found in the relationship between Subjective Norm and Perceived Usefulness, nor between Image and Perceived Usefulness. The regression coefficient (β) between Job Relevance and Perceived Usefulness was .488 ($p < .001$). The regression coefficient between Result Demonstrability and Perceived Usefulness was .242 ($p < .001$). The regression coefficient between Output Quality and Perceived Usefulness was .181 ($p = .003$).

An additional component was the hypothesis that Experience may have had a mediating influence on the link between Subjective Norm and Perceived Usefulness. Results found that whether the direct link between those two variables was measured or a partial correlation was taken controlling for Experience, the values were very close ($r = .224$ vs. $r = .219$). Thus Experience played virtually no role in the Subjective Norm – Perceived Usefulness relationship.

In creating the proposed model, it was evident that Subjective Norm and Image had only limited significance in the correlations and no influence whatsoever in the regressions. Clearly, any variability explained by Subjective Norm and Image was almost entirely consumed by the other three predictors. Because of this, the Perceived Usefulness component of the revised model was rendered with three predictors. The high correlation between Subjective Norm and Image in the present model was immaterial. Figure 3 below demonstrates this structure.
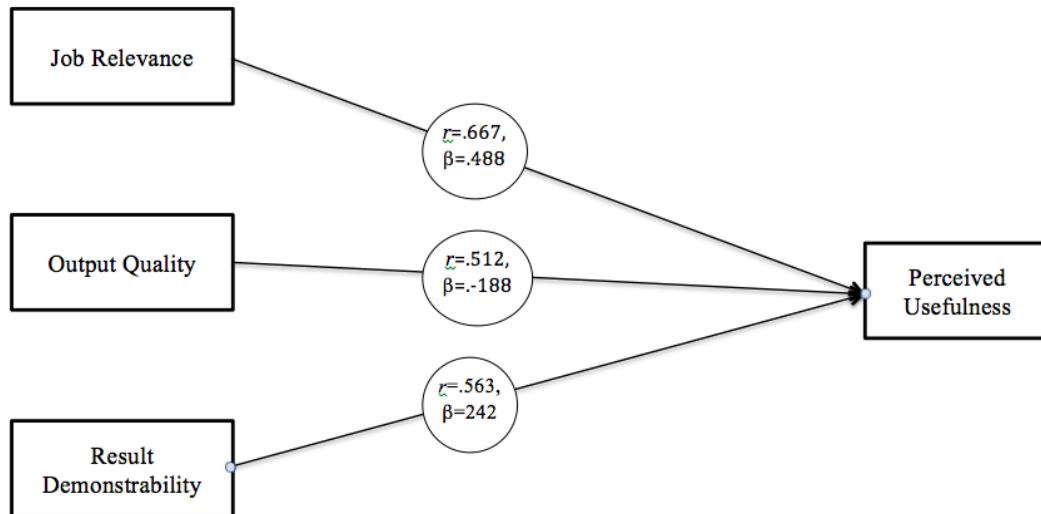
Figure 3. Revised Model: Perceived Usefulness and its Components

Predictors of Perceived Ease of Use

The second component examined was Perceived Ease of Use and its derivative components. Once again, all *p* values were two-tailed. The correlation between Computer Self-Efficacy and Perceived Ease of Use was .122 (*ns*); between Perceptions of External Control and Perceived Ease of Use .526 ($p < .001$); between Computer Anxiety and Perceived Ease of Use -.083 (*ns*); between Computer Playfulness and Perceived Ease of

Use .005 (*ns)*; between Perceived Enjoyment and Perceived Ease of Use .685 ($p < .001$); and between Objective Usability and Perceived Ease of Use .132 (*ns).*

A stepwise multiple regression was performed on these variables with a criterion variable of Perceived Ease of Use, and the other six variables as predictors. The beta coefficients for Computer Self-Efficacy, Computer Anxiety, and Objective Usability were non-significant. Perceived Enjoyment yielded a beta of .57 ($p < .001$). Perceptions of External Control yielded a beta of .30 ($p < .001$). Computer Playfulness yielded a beta of -.23 ($p < .001$).

Both correlational analysis and regressions strongly support the inclusion of Perceptions of External Control and Perceived Enjoyment as primary predictors of Perceived Ease of Use. Both types of analysis support this conclusion at the $p < .001$ level. By contrast it is evident that with this data set, Computer Self-Efficacy, Computer Anxiety, Objective Usability, and Computer Playfulness had no effect on Perceived Ease of Use in correlational analysis. When regressions were conducted, the first three predictors, as expected, had no significant influence on Perceived Ease of Use.

The influence of Computer Playfulness in the regression analysis produced a very rare and counter-intuitive *negative* Beta weight of -.23 with significance less than .001. In correlational analyses Computer Playfulness had no influence ($r = .005$) on Perceived Ease of Use. What had happened in this stepwise regression analysis is that with the two variables already entered (Computer Playfulness was the third variable entered), correlations of the former two variables sufficiently affected the influence of Computer Playfulness to yield the negative and significant correlation. A mathematician would

regard this as a statistical abnormality and fall back to the zero correlation as the more accurate measure of this influence.

The revised model for predictors of Perceived Ease of Use, then, includes Perceptions of External Control and Perceived Enjoyment. Figure 4 below illustrates this.
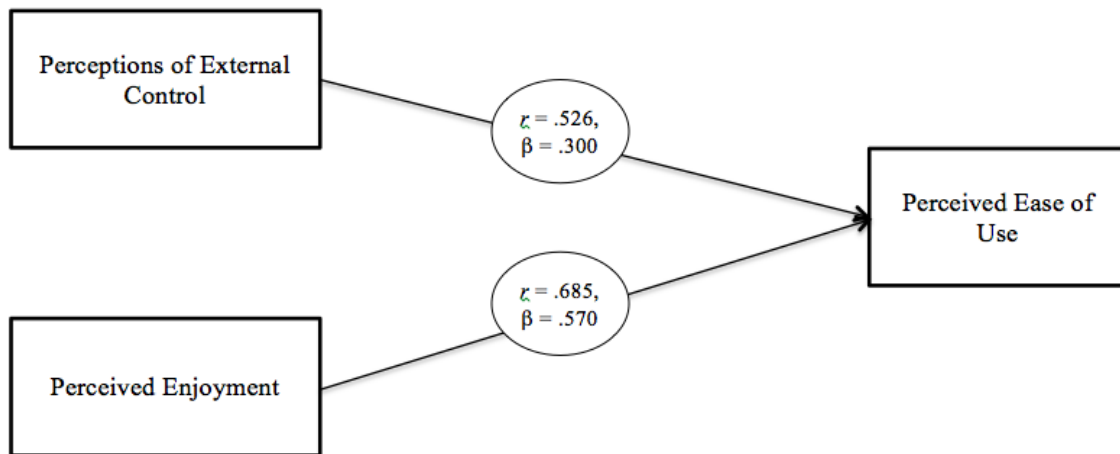
Figure 4. Revised Model: Perceived Ease of Use and its Components

Influences of other Variables on the Core Model

Before the final proposed model is crafted, five variables need to be considered. Two of these variables are in the TAM 3 model: Experience and Voluntariness. Two of these variables are new to the present model and are hypothesized to influence several variables in the final proposed model, Overload and Change Fatigue. Finally, a measure of Satisfaction with the present LMS is measured with no hypothesized relationship in the final proposed model.

Experience

Experience was hypothesized to mediate the effect of 1) Subjective Norm on Perceived Usefulness and the link between 2) Subjective Norm and Behavioral Intention.

The first link has already been discussed (above) - no effect of Experience is measured on the link between Subjective Norm and Perceived Usefulness. There was an almost identical finding for the link between Subjective Norm and Behavioral Intention. The bivariate correlation between these two was .270 ($p < .001$). When the same variables were correlated controlling for Experience, there was essentially no difference from the original bivariate correlation: partial $r = .267$ ($p < .001$). These results suggested no influence of Experience on either of these links. Possible reasons why are explored in the Discussion section.

While Experience did not influence those links, faculty members with more experience (greater number of years teaching) were significantly found to use the LMS less, have lower intention to use it, perceive the LMS as less useful, perceive the LMS as more complex (marginally significant here), perceive the LMS as less relevant to their job, show lower computer playfulness, have lower computer self-efficacy, and demonstrate higher computer anxiety. Table 11 illustrates this pattern of correlates.

Voluntariness

Voluntariness was hypothesized to mediate the link between Subjective Norm and Behavioral Intention. The bivariate correlation between Subjective Norm and Behavioral Intention was .270 (p < .001). The partial correlation between the same two variables in which Voluntariness is used as a control variable produces a partial correlation of .202 ($p = .004$). This result suggested that Voluntariness influenced the link between Subjective Norm and Behavioral Intention, that is, the influence of Subjective Norm on Behavioral Intention was partially explained by whether or not the use of the LMS was voluntary. Implications of this finding are explored in the Discussion section.

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Table 11

Correlations between Experience and Significant Variables

| | Experience | | |
	Pearson Correlation	Sig. (1-tailed)	N
Use Behavior	-.245**	.000	200
Behavioral Intention	-.176**	.006	200
Perceived Usefulness	-.194**	.003	200
Perceived Ease of Use	-.098	.083	200
Job Relevance	-.189**	.004	200
Computer Self-Efficacy	-.306**	.000	200
Ln of Anxiety	.168**	.009	200
Computer Playfulness	-.154*	.015	200

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Further exploration found that Voluntariness had a significant impact on several of the central variables in the model. In descending order, Voluntariness was found to be significantly correlated with the central dependent variable, Use Behavior ($r = -.281$, $p < .001$), as well as Behavioral Intention ($r = -.268$, $p < .001$), Perceived Ease of Use ($r = -.220$, $p = .002$), and Perceived Usefulness ($r = -.185$, $p = .009$). The consistent pattern of negative correlations means that if use of the LMS were voluntary that there would be less use behavior, less behavioral intention, and to a lesser extent the LMS would be seen as less easy to use and less useful. Implications of these findings are addressed in the Discussion section. The correlates of Voluntariness are found in Table 12.

Table 12

Correlations Between Voluntariness and Other Variables

	Voluntariness		
	Pearson Correlation	Sig. (1-tailed)	*N*
Use Behavior	-.281**	.000	200
Behavioral Intention	-.268**	.000	200
Overload	.174**	.007	200
Subjective Norm	-.323**	.000	200
Perceived Usefulness	-.185**	.004	200
Job Relevance	-.279**	.000	200
Output Quality	-.210**	.001	200
Results Demonstrability	-.259**	.000	200
Perceived Ease of Use	-.220**	.001	200
Percept. of Ext. Control	-.154*	.015	200
Ln Anxiety	.146*	.019	200
Computer Anxiety	.184**	.005	200
Perceived Enjoyment	-.212**	.001	200
Satisfaction	-.131*	.032	200

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Overload

Overload was hypothesized to reduce Behavioral Intention. This hypothesis was not supported. In fact, Overload was not significantly correlated with any of the four central variables of the model. For Use Behavior and Behavioral Intention, correlations did not even approach significance. For Perceived Usefulness and Perceived Ease of Use the correlations were positive (.11 and .13 respectively) and using one-tailed significance, these correlations would be classed as the marginally significant. This modest finding suggested that when overloaded, there appeared to be the perception that the LMS would assist in helping faculty members solve the problem of overload.

Change Fatigue

Change Fatigue was hypothesized to have a negative impact on Behavioral Intention. This hypothesis was supported. In fact, Change Fatigue had a significant impact on several of the central components of the model. The greatest effect was on the link between the hypothesized Change Fatigue and Behavioral Intention ($r = -.422$, $p < .001$). The influence on Use Behavior was significant but much smaller than the influence on Behavioral Intention ($r = -.240$, $p = .001$). The major drop in value suggested that Behavioral Intention mediated the influence of Change Fatigue on Use Behavior. Change Fatigue was also significantly associated with Perceived Usefulness ($r = -.298$, $p < .001$) and Perceived Ease of Use ($r = -.360$, $p < .001$). Directionality was difficult to determine on these latter two correlations, but it is clear that if the LMS were not perceived as useful or was difficult to use that Change Fatigue would be higher.

Satisfaction

Satisfaction was measured but was not hypothesized to affect the model in any given anticipated direction. The pattern of correlates with the central variables (ordered by size of the r value) find satisfaction significantly associated with Perceived Ease of Use ($r = .566$, $p < .001$), Behavioral Intention ($r = .465$, $p < .001$), Perceived Usefulness ($r = .396$, $p < .001$), and Use Behavior ($r = .282$, $p < .001$). Although bi-directionality is always a possibility, it might be assumed that Satisfaction operates as the dependent with the other four variables as predictors.

<div align="center">The Final Proposed Model</div>

The final proposed model includes Perceived Usefulness and Perceived Ease of Use as two of the original TAM predictors of Behavioral Intention. As noted earlier in this section, Job Relevance, Output Quality, and Result Demonstrability predict Perceived Usefulness. These variables are included in the final model. Likewise, Perceptions of External Control and Perceived Enjoyment predict Perceived Ease of Use. These are also included in the final model.

Although Perceived Usefulness and Perceived Ease of Use are highly correlated with Use Behavior (rs $= .646$ and $.534$ respectively), those links are not included in the final model due to the much higher correlations of those two variables with Behavioral Intention (rs $= .740$ and $.644$ respectively) and due to theoretical issues addressed in the Discussion section.

A stepwise regression analysis was also run using Behavioral Intention as the dependent variable and Perceived Usefulness and Perceived Ease of Use as predictors to determine the relative influence of each variable. The regression analysis [$R(2, 197) =$

<div align="center">99</div>

.570, p < .001; R^2 = .578)] found Perceived Usefulness to have much greater influence (β

= .570) on Behavioral Intention than Perceived Ease of Use (β = .242), both significant at

p < .001 level.

Voluntariness was included in the TAM 3 model, but only as a mediating

influence on the link between Subjective Norm and Behavioral Intention. Since

Subjective Norm no longer qualifies to remain in the model, Voluntariness is now used as

a direct predictor of Behavioral Intention. The correlation between the two variables

(*r* = -.268, *p* < .001) is robust and the negative correlation suggests that the greater the

perception that use behavior is voluntary, the lower the intention to use the LMS.

Voluntariness is also significantly correlated with Use Behavior (*r* = -.281, *p* < .001) but

for theoretical reasons is not included in the final model. The exclusion of Voluntariness

is further addressed in the Discussion section.

Change Fatigue is the one new variable included in the final model. Change

Fatigue is negatively correlated with Behavioral Intention (*r* = -.422, *p* < .001) and with

Use Behavior (*r* = -.240, *p* < .001). The link between Change Fatigue and Behavioral

Intention is included in the final model. For both mathematical (note the substantial drop

in correlation when predicting Use Behavior) and theoretical reasons the link between

Change Fatigue and Use Behavior is not included.

Finally, the link between Behavioral Intention and Use Behavior is a substantive

.646 (p < .001) and Behavioral Intention is the only direct link with Use Behavior in the

model. The core model is shown in Figure 5 and the complete new model is shown in

Figure 6.
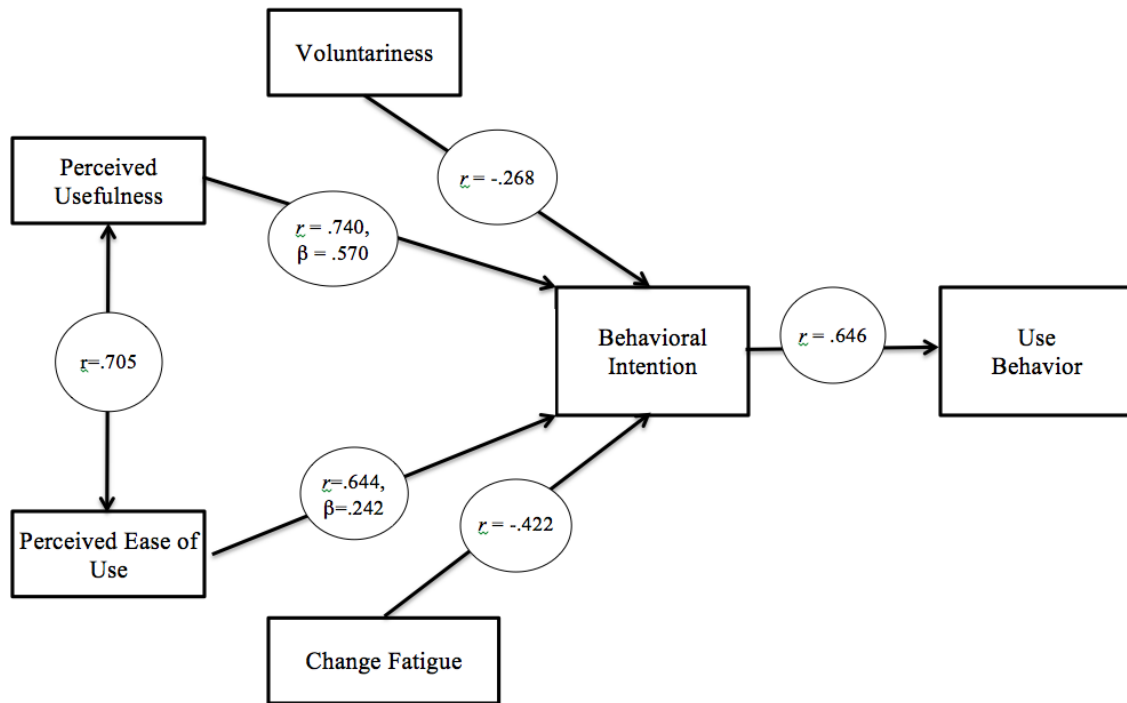
Figure 5. Proposed Model - Core Elements
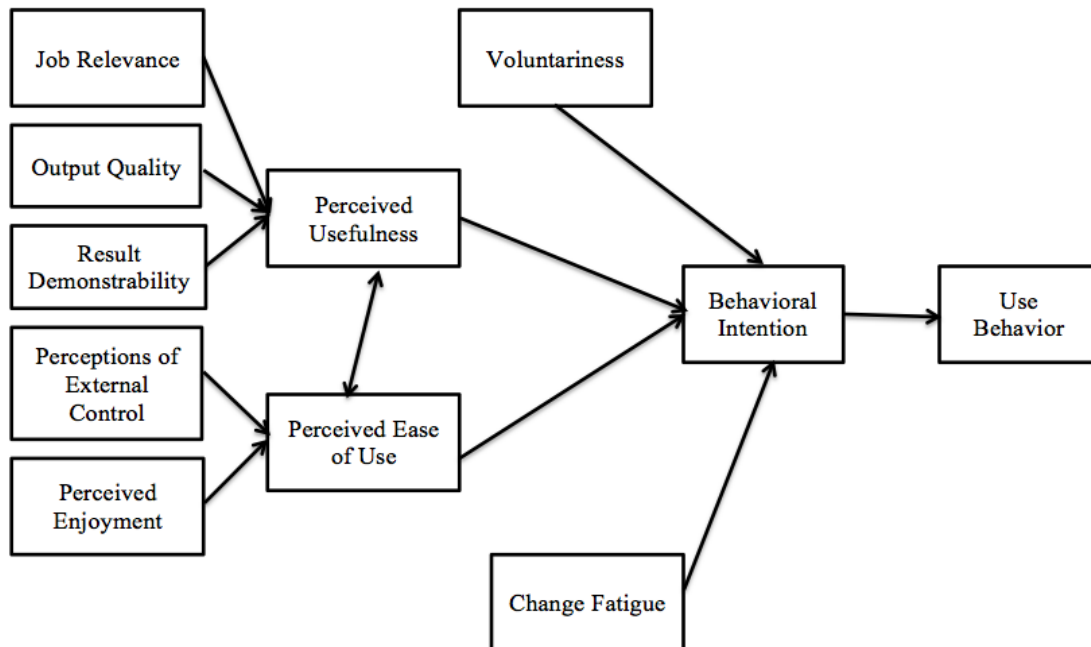
Figure 6. Complete Proposed Model of Use Behavior

CHAPTER 5

DISCUSSION

This chapter comments further on the results found through the study.

Demographics, psychometrics, and research hypotheses are explored. As a revised model

is being proposed, the inclusion of some links and the establishment of other links are

defended, leading to the description of the proposed revised model. The chapter ends

with theoretical implications and applications for university administrators and suggested

future research directions.

Demographics

Gender

Considering gender as a factor, the study shows that there is a substantial

similarity between genders on most variables. The only differences are that women are

more influenced by subjective norm, are more concerned about their image, and have

fewer years of experience. These three areas of difference are areas that do not have a

significant impact on the revised model. If major differences were to occur on central

variables there might be an argument for creating separate models for men and women.

Since that was not the case, a single model is quite satisfactory.

Women tend to be more influenced by subjective norm and image (Venkatesh &

Morris, 2000; Venkatesh, Morris, & Ackerman, 2000). Women also have taught a fewer

number of years, suggesting that women have not always had the kind of representation in academia as is currently enjoyed. Women represent 40% of the sample while men represent 60% of the sample. In 1977, United States Higher Education new faculty were 66% men and 34% women while in 1985, new faculty were 62% men and 38% women (Lomperis, 1990). Total faculty in 1977 were 72% men and 28% women, and in 1985, 67% men and 33% women. By way of example, Canadian Union College in 1970 had 89% total male and 11% female faculty members. CUC (now Burman University) now has 67% male and 33% female faculty members.

There is no evidence in the present study for treating genders differently when it comes to implementing or changing LMSs. There are no significant differences when it comes to the factors that speak the loudest in determining adoption and use of LMSs.

Ethnicity

Comparison of the ethnic divisions using the four main variables (Use Behavior, Behavioral Intention, Perceived Usefulness, and Perceived Ease of Use) finds no significant pairwise differences. However, examining means shows that the mixed/other group is lower than other groups on the dimensions Use Behavior, Perceived Usefulness, and Perceived Ease of Use, and in a virtual tie with Asians for the lowest score in Behavioral Intention. While these results are interesting, the lack of significance suggests no group needs special attention in order to increase LMS usage, as far as ethnic lines go.

Experience

Experience, operationalized in this study as the total number of years teaching at the university level, is positioned in TAM 3 as mediating between Subjective Norm and

Perceived Usefulness and mediating between Subjective Norm and Behavioral Intention. In the present study both links are non-significant and so Experience is not found in the proposed model. Despite the absence of effect here, Experience turns out to be a significant player due to its influence on other variables. While the present study does not attempt to fit Experience into the proposed model, it lends insight into the dynamic of the influence of Experience with other computer-related variables.

Those with more experience (greater number of years teaching) are significantly found to use the LMS less, have lower intention to use it, perceive the LMS as less useful, perceive the LMS as more complex (marginally significant here), perceive the LMS as less relevant to their job, show lower computer playfulness, have lower computer self-efficacy, and demonstrate higher computer anxiety.

This pattern of correlates with Experience demonstrated in the Results section (Table 11) illustrates reasons why those who have been teaching longer are more resistant to the use of the Learning Management System. They are less comfortable with computers in general and place lower value on LMSs. More recently hired faculty members tend to be digital natives, having grown up after the introduction of these technologies. Their early introduction to computer technology leads them to be more intuitively oriented toward technology and LMSs, to see their value, and to be more likely to use them.

Differences Between Universities

Substantial differences are found in the nine universities' ratings of the four central variables (Use Behavior, Behavioral Intention, Perceived Ease of Use, and Perceived Usefulness). It is interesting to note that the two universities with higher

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ratings both use *Canvas* while the universities on the lower end of the comparisons use *Desire2Learn* (two universities) or *Blackboard*. The direct evaluation of LMSs follows. Another factor that exhibits significant differences is that of Voluntariness. Significant correlates with Voluntariness can be found in Table 12 in the Results section.

Voluntariness is negatively correlated with all of the positive determinants in the model, suggesting that those universities that mandate use of the Learning Management System experience higher compliance. The top three universities where system use is perceived to be mandatory (non-Voluntary) (Loma Linda University, Washington Adventist University, and Pacific Union College) represent the highest, second highest, and fifth highest in Use Behavior. At the three universities where LMS use is perceived to be most voluntary (Union College, La Sierra University, and Southern Adventist University), Use Behavior ranks third, seventh, and eighth. The correlations are not perfect, but, along with other factors, it is evident that voluntariness indeed plays a role in influencing LMS use among faculty members. As a generally autonomous group, faculty members often opt out of requirements and expectations that are not communicated as mandatory and where non-compliance does not have negative consequences.

Learning Management Systems

The LMS *Canvas* achieves significantly higher ratings than all other LMSs on the three central variables with significant differences (Use Behavior, Perceived Usefulness, Perceived Ease of Use). It is likely that other factors, including Voluntariness, even out the values for Behavioral Intention. Behavioral Intention is not considered here because intent to use an LMS is more associated with administrative urgings than with the relative merit of a particular system. In fact, most faculty members would not be aware of the

relative merits of the LMS used at their university as compared with others. The features of a specific LMS are more directly tied to Perceived Usefulness and Perceived Ease of Use rather than comparison to another system.

Canvas has developed a superior reputation for designing a user experience that faculty members will enjoy. "From a teaching perspective the layout and ease of use of *Canvas* was much better." (Gregory, 2014) Since Perceived Ease of Use is strongly correlated (.704) with Perceived Usefulness, and both of them are strongly correlated with Behavioral Intention, this helps to explain why, in the words of its developer, Instructure, *Canvas* is adopted "faster and deeper" (Instructure, 2015) than other LMSs. This claim is backed up with evidence comparing the adoption rates at various universities with the dramatically increased degree of adoption using *Canvas*. Indiana University piloted *Blackboard*, *D2L* and *Canvas* and concluded that with *Canvas*, "all of the essentials are present and implemented with an elegant simplicity, efficiency, and exceptional usability (IU Committee, 2013, p. 6). The usability of *Canvas* is so exceptional that "most faculty and students can start using the application with little or no documentation or training" (IU Committee, 2013, p. 9).

Psychometrics

Only one variable, Computer Anxiety, with a kurtosis value of 3.01, showed unacceptable psychometrics. Kurtosis measures the peakedness or flatness of a particular distribution. The reason for the high kurtosis is simple: a large number of faculty members (61% of our sample) disagree strongly with the statement "I get dysfunctionally nervous when working with computers." This produced the unacceptable kurtosis, and also an extreme skewness value (1.87). However, the skewness value was not enough to

automatically disqualify the variable whereas the kurtosis value was. An interesting side note is that only one faculty member answered the Computer Anxiety question with "Strongly Agree." This individual had been with a university for the longest time in our sample: 42 years. This lends anecdotal support to the previous discussion about the influence of Experience. The problem of psychometric distortion was solved by using the natural logarithm of Computer Anxiety (skewness 1.04, kurtosis -.19) in analyses involving the Anxiety variable.

In the Results section the portion dealing with missing values (2.5 pages including a lengthy table) may seem like overkill. Only 3.4% of values were missing and the actual process of replacing those missing values was straightforward and uneventful. The reason was simply to be thorough and to use the best technique possible for replacing those values. When the entire dataset was available to create regression equations for predicted values, that was done. When questions were university- or LMS-specific, the number of participants was greatly reduced for a particular category and it was necessary to use the mean value since the statistical power was not great enough to create valid regression equations.

Technology Acceptance Model and Research Hypotheses

The research hypotheses evaluate a variety of variables within the TAM 3 model examining factors influencing the adoption of LMSs by faculty members in Adventist universities. These hypotheses are derived from the relationships evident in the TAM 3 model and two were added to test two additional constructs.

Hypothesis 1: Subjective Norm is positively and directly correlated with Image.

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Hypothesis 2: Perceived Usefulness is directly and positively correlated with Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability.

Hypothesis 3A: Perceived Ease of Use is directly and positively correlated with Computer Self-Efficacy, Perceptions of External Control, Computer Playfulness, Perceived Enjoyment, and Objective Usability.

Hypothesis 3B: Perceived Ease of Use is directly and negatively correlated with Computer Anxiety.

Hypothesis 4: Perceived Usefulness is directly and positively correlated with Perceived Ease of Use.

Hypothesis 5: The influence on Perceived Usefulness of Subjective Norm is mediated by Experience.

Hypothesis 6: Behavioral Intention is directly and positively correlated with Perceived Ease of Use.

Hypothesis 7: Behavioral Intention is directly and positively correlated with Perceived Usefulness.

Hypothesis 8: Behavioral Intention is directly and positively correlated with Subjective Norm.

Hypothesis 9: The influence on Behavioral Intention of Subjective Norm is mediated by Experience.

Hypothesis 10: The influence on Behavioral Intention of Subjective Norm is mediated by Voluntariness.

Hypothesis 11: New to the model, Behavioral Intention is directly and negatively correlated with Overload.

Hypothesis 12: New to the model, Behavioral Intention is directly and negatively

correlated with Change Fatigue.

Hypothesis 13: Use Behavior is directly and positively correlated with Behavioral

Intention.

The results of this study demonstrate an interesting shift in dynamics since the

Technology Acceptance Model and its various modifications were introduced in 1989,

2000, and 2008. The initial model was limited and over time additional constructs were

added. Comments on the shift in dynamics from the TAM come later in this section.

Hypothesis 1 suggests that Subjective Norm is positively and directly correlated

with Image. This hypothesis is supported by the study ($r = .437$, $p < .001$) and likely

reflects the interaction between receptivity to pressure from others and the personal desire

for improvement of status within one's institutional social group. Subjective norm is the

pressure faculty members feel from others (both faculty and administration) in the

institution to use the innovation, essentially, peer pressure. Image reflects the degree to

which the use of the innovation will enhance status in the peer group. It makes good

sense that these two are connected.

Hypothesis 2 suggests that Perceived Usefulness is directly and positively

correlated with Subjective Norm, Image, Job Relevance, Output Quality, and Result

Demonstrability. Results suggest the influence of the passage of time (from the year 1989

when the TAM model was first conceived, to variations through 2000 and 2008 and the

present study in 2015) in the pattern of influence of these five variables on Perceived

Usefulness. While four of the variables are significantly correlated with Perceived

Usefulness, only three variables retain significance in the regression equations: Job

Relevance ($r = .667$, $\beta = .488$, both p's $< .001$), Result Demonstrability ($r = .563$, $\beta =$ .242, both p's $< .001$), and Output Quality ($r = .512$, $p < .001$, $\beta = .181$, $p = .003$). The other two predictors (Subjective Norm and Image) produce positive correlations with Perceived Usefulness but both correlations are weak.

In the cases of Subjective Norm and Image, correlations suggest a positive but weak influence on Perceived Usefulness, but in the regression equations, neither variable has any influence whatsoever. This suggests that the more powerful effects of Job Relevance, Output Quality, and Result Demonstrability entirely consume any variance provided by Subjective Norm and Image.

These findings suggest the influence of the passage of time. It is evident that faculty members would desire adopting technology that is relevant, will help them teach well, and has tangible evidence of results. Those are strong and enduring reasons for technology to be favored and utilized (Al-Busaidi & Al-Shihi, 2010; Alharbi & Drew, 2014; Yi, Jackson, Park, & Probst, 2006). However, there is an expectation that faculty today will be able to use computer technology effectively and there is much less sense of the need for peer pressure within the academy to be a factor in encouraging faculty to use LMSs. Regarding Subjective Norm, every university has an expectation that individuals would be able to use a computer effectively. Twenty-five years ago, universities were going through the painful process of the shift to computer usage. By the year 2000, it is believed that most professors were engaged and involved with computer usage, with a few holdouts. There were still a few not fluent in use of technology. For example, a survey of faculty at University of California Davis in Fall 2000 found that 68% of faculty used computers in class more than half the time, and 96% used computers in class some

of the time or more (Leamy, 2000). The relative weakness of this variable suggests a shift over time. Most university faculty members today are not influenced by peer pressure in their use of LMSs.

Even weaker is the influence of Image. A similar study of instructional technology involving iPads found that social status (Image) was not a significant influencing factor when it comes to the adoption of that technology (Lane & Stagg, 2014).

Hypothesis 3A suggests that Perceived Ease of Use is directly and positively correlated with Computer Self-Efficacy, Perceptions of External Control, Computer Playfulness, Perceived Enjoyment, and Objective Usability. Results suggest that Perceptions of External Control ($r = .526$, $p < .001$, $\beta = .296$, $p < .001$) and Perceived Enjoyment ($r = .685$, $p < .001$, $\beta = .570$, $p < .001$) have a strong influence upon Perceived Ease of Use. The sense that the LMS is supported by the organizational infrastructure and technical support is available is comforting to faculty. It is also natural that faculty who enjoy using an LMS will at the same time perceive it to be easy to use.

Computer Self-Efficacy ($r = .122$, $p = .043$) and Objective Usability ($r = .132$, $p = .032$) are both weak but significant factors in determining Perceived Ease of Use. However, in regression, the partial correlations indicate that neither has any effect on the model. Again, it is apparent that over time, the level of computer skill has risen among faculty where these issues are no longer relevant when it comes to Perceived Ease of Use.

Computer Playfulness has an interesting effect in the model. While it is not statistically significant ($r = .005$, $p = .472$) in the correlation, it is significant in the regression ($\beta = -.231$, $p < .001$) and its effect is negative. This unusual finding of a

variable that has a small and non-significant positive correlation with the dependent variable should in a regression equation result in a significant negative effect requires some thought. Mathematically, Computer Playfulness has been entered after the highly influential Perceptions of External Control and Perceived Enjoyment have been entered in the equation. The effect of these two skews the effect of the Computer Playfulness so that its influence on the dependent variable is now significant and negative. This mathematical oddity is typically ignored and the initial zero correlation is considered the more useful statistic.

Conceptually, this also seems strange, as one would normally expect that a sense of playfulness around computers would be associated with a sense of ease of use. Computer Playfulness is intended to measure intrinsic motivation and was theorized to diminish over time (Al-Gahtani, 2014). As a concept, Computer Playfulness addresses the interactions with computers and not necessarily the work-specific elements of LMSs. The computer used by faculty to be effective in their job is rarely thought of as a toy. For faculty, Computer Playfulness can be expressed outside of the workplace.

Hypothesis 3B suggests that Perceived Ease of Use is directly and negatively correlated with Computer Anxiety. Computer Anxiety does not significantly influence Perceived Ease of Use ($r = -.083$, $p = .243$), reflecting the findings in which no direct effect on Perceived Ease of Use by Anxiety was found (Venkatesh, et al., 2003). This likely reflects the trends of digital natives and increasingly comfortable digital immigrants using computers and LMSs, as well as the rise of digital wisdom.

Hypothesis 4 proposes that Perceived Usefulness is directly and positively correlated with Perceived Ease of Use. Results suggest that a very strong link exists

($r = .705$, $p < .001$). When faculty members are dealing with an LMS that is intuitive,

well designed, and easy to operate, faculty tend to discover and appreciate the features of

the LMS that make it more useful. Computers as a whole became more useful when the

operating systems began to incorporate graphical user interfaces and increasingly became

more user-friendly. A similar effect is evident here.

Hypothesis 5 suggests that the influence on Perceived Usefulness of Subjective

Norm is mediated by Experience. This hypothesis is entirely unsupported. When the link

between Subjective Norm and Perceived Usefulness ($r = .224$, $p = .001$) is controlled for

Experience ($r = .219$, $p < .002$), the effect of Experience is negligible. Why there is no

effect may be suggested by increased computer fluency by almost everyone with the

passage of time.

This non-effect reflects the non-effect of Experience as an influencing variable. In

this study, Experience is measured by the number of years the faculty member has been

teaching. The longer a faculty member teaches, the more experience they can be expected

to have with the LMS at their institution. The length of time a faculty member has been

teaching has virtually no effect on the impact Subjective Norm has on Perceived

Usefulness. Subjective Norm represents the pressure faculty feel from administrators and

peers to use an innovation. Experience does not play a role with pressure to innovate, and

no matter how much pressure a faculty member feels, Experience does not play a role in

translating that pressure into a sense that the LMS is useful.

Among survey respondents, there are those who have been teaching one year and

those who have been teaching for 42 years. One might expect the first-year teacher to be

more susceptible to peer pressure toward valuing useful features of an LMS. Or a 72-

year-old faculty member, who saw the dawning of technology while in her prime, might

be expected to be more resistant to the pressure of others to find the new LMS useful.

Neither case is borne out by present evidence. It is more likely that each one's experience

with the LMS, the computer skills developed over time (digital wisdom) and the features

of the LMS have the greater impact on how usefulness is perceived.

Hypothesis 6 suggests that Behavioral Intention is directly and positively

correlated with Perceived Ease of Use. This hypothesis is strongly supported with one of

the highest correlations in the data set (.644). It is reasonable that if an LMS is easy to

use, faculty will intend to use it. Many dollars go into research and design of software

applications for this very reason. Systems that are easy to learn and use will promote the

desire on the part of faculty to make use of it. Analysis of Variance shows that *Canvas*

users score significantly higher than all other studied LMSs on Perceived Usefulness,

Perceived Ease of Use, and Use Behavior. This will be discussed further in a later

section.

Hypothesis 7 suggests that Behavioral Intention is directly and positively

correlated with Perceived Usefulness. The link is confirmed with an even higher

correlation than Hypothesis 6 in the present research ($r = .740$, $p < .001$). This

confirmation suggests that Adventist faculty members are strongly influenced by the

usefulness elements of LMSs and intend to use systems that they perceive to enhance

their ability to deliver quality education.

Hypothesis 8 suggests that Behavioral Intention is directly and positively

correlated with Subjective Norm. The link is confirmed by the present research ($r = .270$,

$p < .001$) although it is nowhere near as strong as the link between Perceived Usefulness

and Behavioral Intention. The positive correlation does suggest, however, that the influence of peer opinions and administrative desires has some influence on Adventist faculty intention to use an LMS. As social animals, there is a desire to fit in and live up to the expectations of others. However, due to a weak pattern of correlates between Subjective Norm and other variables, it is not included in the final model. The reasons are discussed later in the dissertation.

Hypothesis 9 suggests that the influence of Subjective Norm on Behavioral Intention is mediated by Experience. This relationship is similar to Hypothesis 5, except that Behavioral Intention takes the place of Perceived Usefulness in this hypothesis. It too requires a partial correlation to determine the effect of Experience on the relationship between Behavioral Intention and Subjective Norm. Once again, there is a negligible difference in the link without Experience ($r = .270$, $p < .001$) and the link mediated by Experience ($r = .267$, $p < .001$). Experience has virtually no impact on the link between Behavioral Intention and Subjective Norm. Therefore, this hypothesis is not supported by this study. Subjective Norm is not as strongly associated with Behavioral Intention as other variables, and present results suggest that this link is not influenced by whether one is new to teaching or a veteran.

Hypothesis 10 suggests that the influence on Behavioral Intention of Subjective Norm is mediated by Voluntariness. This hypothesis is supported. Subjective Norm, the pressure of those whose opinion the faculty member cares about, increases the likelihood of faculty intent to use the university's LMS ($r = .270$, $p < .001$). When Voluntariness is included as a mediating variable, the effect of Subjective Norm on Behavioral Intention

lessens ($r = .202$, $p = .004$). This suggests that peer pressure is moderated by the sense faculty may have that they have a choice about using the LMS.

Hypothesis 11 suggests that Overload is directly and negatively correlated with Behavioral Intention. This hypothesis is not supported ($r = .048$, $p = .251$). Overload may have a painful and significant influence on many things, but it does not (in the present study) have any impact on Behavioral Intention. Perhaps, over the past fifteen years, as faculty members have become increasingly comfortable with technology and their LMSs, it has not been viewed as either part of the problem or part of the solution to overload. There are undoubtedly individual differences where some view the LMS as helping to resolve issues of overload, while others view it as part of the problem. Present results, however, suggest that there is no consistent influence of overload on variables associated with use of an LMS.

Hypothesis 12 suggests that Change Fatigue is directly and negatively correlated with Behavioral Intention. This hypothesis is robustly supported in the present study ($r = -.422$, $p < .001$). The greater the sense of weariness with change, and the less the confidence in those who are responsible for bringing those changes about, the greater is the sense of frustration in faculty members. This conversely increases the sense of frustration and fatigue in faculty members and increases the negative impact on the intention to use the LMS that may be introduced.

Hypothesis 13 suggests that Use Behavior is directly and positively correlated with Behavioral Intention. This correlation is the ultimate end of the model, where all of the factors supporting Perceived Ease of Use and Perceived Usefulness join in Behavioral Intention. A very strong correlation is apparent between Behavioral Intention and Use

Behavior ($r = .646$, $p < .001$). For instance, the legendary Reasoned Action Model from social psychology proposed by Fishbein and Ajzen (2011) also finds that the greatest direct predictor of behavior is behavioral intention.

Criteria Explaining Why Specific Links are Included in the Final Proposed Model

In the TAM 3 model there are 17 variables and 20 links between those 17 variables. There is no doubt that there are more than a hundred additional significant correlations between variables that theoretically might be used in the final model. The total number of possible links in a model with 17 variables is 153 possibilities. There are several reasons that all significant links are not included in the TAM 3 model (and in the proposed model as well).

1. Models, first and foremost, have a pragmatic role; their nature is to be functional. That is, models provide theory that is useful to those involved in (in this case) selection, management, change, and use of an LMS. The words of renowned psychologist Kurt Lewin (1952) are entirely relevant: "There is nothing so practical as a good theory" (p. 163). Including all statistically significant links would make the theory so complex as to be useless.

2. The entire concept of mediating variables is another major factor. This concept is analogous to the "third variable" problem so often discussed in correlational research. The classic example: In New York City the sale of ice cream and incidence of murder are highly correlated. While this is a fact, when one begins to determine causality, support cannot be found for "eating ice cream gives one murderous impulses" or "committing

murders gives one a craving for ice cream." There is a third (or mediating) variable: temperature. When it is hot more ice cream is sold and there is more violent crime (Rosenthal, 2012). Many of the significant links in a complex model would fall into this category.

3. Models are useful for determining causality. The function of a model of this nature is to determine what causes what. Regrettably, most of the research that explores these issues is correlational in nature, as is the present study. It is logical to accept that Behavioral Intention "causes" Use Behavior. However, many of the links are not so straightforward. For instance, two of the major players in the final model, Perceived Usefulness and Perceived Ease of Use are highly correlated with an r-value $> .7$. That is one of the highest correlations in the entire data set, but it is not useful in determining the direction of causation and doesn't benefit a model where the intention is to determine what causes what. In the final revised model they are shown as highly correlated but not predictive.

4. Artistry: As much as researchers would like to think that analysis of data answers all questions, there are several statistical procedures that appear to be more of a work of art than an engineered model. With Factor Analysis, in which the researcher will attempt many models with different methods of extracting factors or rotating factors to a final solution, the goal is to eventually find a model that best fits the data. The same may be said for Cluster Analysis, Log Linear Models or Structural Equation Modeling. Now a good fit and a poor fit are all consistent with the data; it is just that the researcher is attempting to find the best fit consistent with the data.

In the present context, this study is attempting to create a good (that is, useful) model that is consistent with the data. One of the extraordinary examples in the present study is that Voluntariness correlates -.27 with Behavioral Intention and -.28 with Use Behavior. This creates a quandary for a researcher. Should the direct link between Voluntariness and Use Behavior be included in the final model? Logic suggests that the link to Behavioral Intention is more important since Behavioral Intention is the greatest direct predictor of behavior. In this case, further analysis assists. When the partial correlation between Voluntariness and Use Behavior controls for Behavioral Intention, the correlation drops from -.28 to -.15. This result suggests that Voluntariness is mediated through Behavioral Intention. However, even this partial correlation is still a significant predictor of Use Behavior. The researcher is forced to make the decision to include the link between Voluntariness and Behavior Intention due to logical imperative with partial support from data analysis. Including the link from Voluntariness to Behavioral Intention and not including the link from Voluntariness to Use Behavior is entirely consistent with the data but is not urged by the data.

The changes from the TAM 3 to the present model are now considered link by link.

The Shift from the TAM 3 to the Proposed TAM Model

Discussion begins with components of the TAM 3 (and earlier TAM models) that were excluded from the present model.

Subjective Norm and Image

The elimination of these two predictors from the present model is determined by the data and is explained by possible changes of perspective over time. Image is not

significantly associated with Perceived Usefulness in the proposed model. While Subjective Norm is significantly correlated with Perceived Usefulness, the correlation value is small when compared to other significant predictors and drops essentially to zero in the regression analysis. The decision is straightforward: these two variables don't belong in the proposed revised model. The correlation between Subjective Norm and Image (proposed in TAM 3) is very much evident in the present study (r = .473), but is now irrelevant since neither variable influences Perceived Usefulness.

The reason is likely due to the passage of time. When the first TAM model was created in 1989, the majority of faculty members had not grown up with computers. Consideration of simple numbers reinforces this idea. Computers became widely available and extensively used in the mid-1980s. In the year 2000 (only 15 years later) no faculty members at the university level would have grown up with computers, as digital natives. All would have learned computer skills in adulthood, as digital immigrants (Prensky, 2005). The year 2015 marks 30 years since computers were widely available and commonly used. A person born in 1975 (40 years old at the time of this writing) would have grown up with computers and anyone under 55 would have used computers extensively during their graduate studies. The use of a computer (particularly at the university level) is no longer associated with subjective norms or with one's image: everyone uses them because it is required for job success.

Computer Self-Efficacy and Computer Anxiety

The elimination of these two predictors from the present model is determined by the data and is also explained by possible changes of perspective over time. Computer Self-Efficacy is not significantly associated with Perceived Ease of Use in the present

model, nor is Computer Anxiety associated with Perceived Ease of Use. Therefore, these two variables can be safely removed from the model.

Computer Self-Efficacy refers to the degree to which an individual believes that he or she has the ability to perform specific tasks or jobs using computers. The measured Computer Self-Efficacy for this sample was 5.43 on a 7-point Likert scale. It was the highest value of all of the Likert-scale measurements taken in the study. The fact that many faculty members now feel confident with computer technology suggests that it no longer has a bearing on how easy to use they perceive the Learning Management System to be. Most faculty members today are competent in learning new software. This has not always been the case, and reflects the improvements in computer ability among faculty over time. Training and long-term professional development has been found to significantly increase computer self-efficacy (Brinkerhoff, 2006; Torkzadeh & Van Dyke, 2002). Computer instruction has been a part of the education and professional development of most professors; this is evident in the high Computer Self-Efficacy scores.

The elimination of Computer Anxiety from the present TAM 3 model is determined by the data and explained by shifts in perspective regarding computer technology over time. Computer Anxiety is not a significant predictor of Perceived Ease of Use. Today's faculty members are competent with computers, highly experienced, and have often received formal training and computer support. As such, they would be expected to have low levels of Computer Anxiety (John, 2015). Since Computer Anxiety is no longer an issue among academics, present research confirms that it has little influence on Perceived Ease of Use.

Computer Playfulness

The elimination of Computer Playfulness from the present TAM 3 model is determined by the data and explained by the nature of university faculty. Other variables that explain Perceived Ease of Use (Perceptions of External Control and Perceived Enjoyment) have so much influence in the equation that Computer Playfulness has become non-significant. The mean score for Computer Playfulness was 5.00 on a 7-point Likert scale reflecting a positive response when it comes to enjoying the resources offered by a computer. The question used, "I like to be creative and have fun when using a computer," in no way implies that their fun and creativity is associated with a Learning Management System. So while Computer Playfulness is not moderately high, it has no bearing on Perceived of Use of an LMS (Al-Gahtani, 2014).

Objective Usability

Venkatesh and Bala (2008) define Objective Usability as "a comparison of systems based on the actual level (rather than perceptions) of effort required to complete specific tasks." While this has the potential to be a useful variable, in a practical sense, it is almost impossible to find faculty members sufficiently acquainted with several different LMSs to make such comparisons. In the present study Objective Usability is operationalized as the amount of time to complete a simple task (enter a test title and include a three word message about technology) using the news feature of the university LMS.

With this definition, Objective Usability was not significantly correlated with Perceived Ease of Use, nor, in regression analysis did the beta weight attain significance.

Because of this, Objective Usability was dropped from the model as a predictor of Perceived Ease of Use.

In theory, it seems that the objective measure (actual speed for doing a simple task on an LMS) should have some influence on the Perceived Ease of Use. One problem may have been that the test that the exercise used was idiosyncratic and may not have been an accurate measure of the usability of a particular LMS. Another common challenge is that objective reality and perception of that reality are often widely divergent (Fiske & Taylor, 1991). In either case, there is no mathematical support for including Objective Usability in the present the model. Perhaps in the future, the variable might be measured in such a way as to demonstrate its usefulness.

Experience as a Mediating Influence

The elimination of Experience from the present TAM 3 model is determined by the data and explained by factors described earlier in this section. In this model, Experience is shown as a mediating link between Subjective Norm and Perceived Usefulness. It is also shown as a mediating link between Subjective Norm and Behavioral Intention. Analysis demonstrated very little influence of Experience on either link. Despite a set of interesting correlates with other variables (described above), Experience may safely be removed from the model.

Overload

Overload is one of two new variables tested in the present model. It was hypothesized that Overload would be negatively correlated with Behavioral Intention. Results uncovered no relationship between the two variables. In fact, Overload has little

influence on any of the variables used in the present study either in direct relationships or as a control variable.

The elimination of Overload from the proposed model is determined by the data and explained by reason. The link between Overload and Behavioral Intention was negatively correlated, as hypothesized, but failed to achieve significance. As such, the link is removed from the model.

Faculty today may have different perspectives on the value of Learning Management System in situations of overload. Some may perceive the LMS as a solution, while others may see the LMS as contributing to the problem. The overall effect, however, is negligible, suggesting that Overload has neither a systematic nor a strong effect on the central components of the proposed model.

The Proposed Model

Predictors of Perceived Usefulness

Both correlations and regressions robustly support the inclusion of Job Relevance, Output Quality, and Result Demonstrability as direct predictors of Perceived Usefulness. The bivariate correlations are substantial, all higher than .5, and the beta weights allow comparison of the relative influence of each of these variables on Perceived Usefulness.

The beta weight for Job Relevance more than doubles the beta weight for the next highest predictors Result Demonstrability (.242) and Output Quality (.181) suggesting the relative importance of the three predictors of Perceived Usefulness. As noted earlier, Subjective Norm and Image were dropped from the model due to their lack of influence.

Predictors of Perceived Ease of Use

Both correlations and regressions robustly support the inclusion of Perceptions of External Control and Perceived Enjoyment as predictors of Perceived Ease of Use. The Perceptions of External Control reflects each participant's confidence in their own ability to control the LMS being used. Thus "external control" is not defined here in a broader sense of control over one's world or one's outcomes, but is entirely focused on one's ability to effectively understand and use the LMS as supported by the institution. The Perceptions of External Control is entirely LMS-focused. This variable is sometimes defined as the perception of support and infrastructure available to assist in using the LMS. The present study included a variable that was more individual- and LMS-focused.

Perceived Enjoyment is also entirely LMS-focused. The statement assessing the quality is "I enjoy myself when using [the LMS]" suggesting both fluency in the LMS and enjoyment of the features and effectiveness of that system. The statement used to assess this variable effectively addresses the core element of effectively using any software. Enjoyment has been found to be a significant predictor of Perceived Usefulness, Perceived Ease of Use and Intention to Use (Teo & Noyes, 2011).

A regression analysis helps to illustrate the relative importance of these two predictors. The regression equation began with the six predictors suggested by TAM 3. Four of those six did not achieve significance (as described above) and the two variables that did remain found Perceived Enjoyment ($\beta = .570$) almost doubling the influence of Perceptions of External Control ($\beta = .300$).

The Central Components of the Model

The four central variables proposed by TAM 3 remained securely in place without challenge. The influence of the predictors of Behavioral Intention produced two of the highest correlations in the data set: Perceived Usefulness correlated .740 with Behavioral Intention (the highest correlation in the model) and Perceived Ease of Use correlated .644 with Behavioral Intention. A regression equation using Behavioral Intention as the criterion variable, with the two central predictors listed above, identified the relative merit of the predictive value of each variable. The beta weight between Perceived Usefulness and Behavioral Intention (.570) more than doubled the beta weight between Perceived Ease of Use and Behavioral Intention (.242).

Now, Perceived Usefulness and Perceived Ease of Use also both have robust correlations with the end variable, Use Behavior (.646 and .534 respectively). This suggests that perhaps the direct links should be included in the final model. However, running partial correlations with Behavioral Intention as the control variable quickly ends that discussion. In the link between Perceived Usefulness and Use Behavior, when Behavioral Intention is used as a control variable, the r drops from .646 to .328. In the link between Perceived Ease of Use and Use Behavior, when Behavioral Intention is used as a control variable the r drops from .534 to .202. The links are still significant, but the power of Behavioral Intention as a mediating variable is undeniable.

Perceived Usefulness and Perceived Ease of Use are highly correlated (.705) but since there is no suggestion of directionality or causality in the model, that correlation is listed in the final model with a bidirectional arrow. The link between Behavioral

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Intention and Use Behavior is strong and positive and retains its status as the most important link in the entire model.

The Influence of Voluntariness

The influence of Voluntariness has been discussed in some detail earlier in this section. For instance, Voluntariness is significantly (and negatively) correlated with both Behavioral Intention and Use Behavior (*r*s of .27 and .28 respectively). The inclusion of a direct link to Use Behavior might be argued, but when the Voluntariness – Use Behavior link includes Behavioral Intention as a control variable, the correlation drops from .28 to .15. Thus, the direct link to Behavioral Intention is retained (and the link to Use Behavior, dropped) as the only link in the final revised model.

The Influence of Change Fatigue

The influence of Change Fatigue has also been discussed in some detail earlier in this section. The correlation between Change Fatigue and Behavioral Intention is negative and substantial: $r = -.422$. Change Fatigue is also significantly correlated with Use Behavior: $r = -.240$. The idea of including this link in the final model is no longer considered when Behavior Intention is used as a control variable. The link between Change Fatigue and Use Behavior entirely disappears (changes from -.240 to +.047) with Behavioral Intention as a mediating variable. The inclusion of the single link between Change Fatigue and Behavioral Intention in the final model is thoroughly justified.

Implications of New Model

Theoretical Implications

The proposed revised model is based on responses of 200 faculty members from nine different Seventh-day Adventist universities. The selected faculty members represent an approximately random sample of faculty from these institutions. The "approximately" reflects the fact that the pool of 323 faculty members was indeed random but the 200 eventual participants were self-selected. In the present context, this is about as well as can be expected without offering major financial incentives. It can then be concluded that the sample is fairly representative of faculty at the nine universities and that valid inferences can be drawn about faculty at Adventist universities in North America. A valid question is whether these results apply to other faith-based and public universities in North America.

The proposed model itself is quite parsimonious compared to the current TAM 3. The total number of variables involved drops from 17 to 11 and the number of links between variables drops from twenty to ten. This more streamlined model facilitates more direct applicability and also allows more advanced forms of data analysis to be conducted to test its validity. For instance Al-Gahtani (2014) actually attempted the challenging task of testing the TAM 3 model with structural equation modeling (SEM). The difficulty of such an effort is due to the large number of variables and the even larger number of links that may be tested simultaneously. While extending beyond the mandate of the present study, a simpler model with 11 variables and 10 links between those variables is much more amenable to use of structural equation modeling to test the viability of the proposed model.

The streamlined model proposed in this dissertation achieved greater simplicity without any reduction in the validity of the predictor variables. The links dropped from the original TAM 3 model are not significant with the data in the present study. All variables that are dropped reflect the changing landscape of technology usage. Every year faculty members at universities includes a growing number of digital natives, a corresponding decline of digital immigrants, and a number with digital wisdom. For digital natives and those with digital wisdom, effective use of a computer is no more reflective of their image nor enhances their social standing than being fluent in their native tongue.

The same rationale applies to the original predictors of Perceived Ease of Use in the TAM 3 model. There are four predictors in the TAM 3 model not included in the proposed model: Computer Self-Efficacy, Computer Anxiety, Computer Playfulness, and Objective Usability. The former three reflect, once again, the increasing percentage of Digital Natives and the Digitally Wise among the faculty of universities. For these individuals, Computer Self-Efficacy and Computer Anxiety are hardly considered as the thousands of hours using a computer since childhood have resulted in high efficacy and low anxiety. Computer Playfulness today appears to be simply unrelated to use of an LMS. The LMS is systematically viewed as a tool to accomplish an academic agenda and any playfulness involving a computer (or other electronic devices) occurs in a different setting.

The elimination of Objective Usability may reflect a measure of that variable that was too limited in scope. Recall that Objective Usability was measured by the time it took each participant to complete a simple task on their LMS. It is entirely possible that if

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the variable reflects a broader range of fluency in the use of an LMS, there may be a significant influence. For future studies it would be urged that a more comprehensive variable be employed. For the present, however, Objective Usability does not significantly impact the model and is not included in the proposed model.

The central four variables remain as potent in the proposed model as in the TAM 3 or in any of its predecessors. Perceived Usefulness and Perceived Ease of Use are both powerful predictors of Behavioral Intention. Regression analysis suggests Perceived Usefulness has more than double the influence as Perceived Ease of Use. These two qualities reflect outstanding features of software designed for any purpose. The two questions asked in every instance are: "Will it do what I want it to do?" and "Is it intuitive and easy to use?" When implementing an LMS, the same questions for this complex and influential software are automatic. Many studies verify that Behavioral Intention is the greatest single predictor of Use Behavior (Al-Gahtani, 2014; Chuan-Chuan Lin & Lu, 2000; Venkatesh & Bala, 2008). The present study confirms those results.

Voluntariness is included in the TAM 3 only as a mediating variable proposed as moderating the influence of Subjective Norm on Behavioral Intention. Subjective Norm has been dropped from the present model and with it, the link that Voluntariness was proposed to influence. Data analysis, however, reveals that Voluntariness has a significant and direct impact on the four central variables. The inclusion of only the link between Voluntariness and Behavioral Intention (since there is an equally strong link between Voluntariness and Use Behavior) is due to the dramatic drop of the latter correlation when Behavioral Intention is included as a control variable. This suggests that

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the path of Voluntariness through Behavioral Intention to Use Behavior is a more accurate representation of the data and of greater practical value. Since all correlations are negative, the reverse statement might be that requiring the use of the LMS significantly increases the intention to use the LMS and its actual usage.

Finally, the new variable, Change Fatigue, proves to have a robust influence on the central variables in the model. The inclusion of only the link between Change Fatigue and Behavioral Intention follows a similar reasoning as for Voluntariness. The only major difference is that the reduction of influence of Change Fatigue and Use Behavior, when controlling for Behavioral Intention, is much greater than for Voluntariness. In fact a strong correlation between Change Fatigue and Use Behavior drops to essentially zero when the control variable is included. This suggests that the path of Change Fatigue through Behavioral Intention to Use Behavior is an accurate representation of the data and has great practical implications. Reproducing the figure included earlier in the paper, the final proposed model is represented in the following diagram, Figure 7.

Leadership Applications

Of the 11 variables used in the model, seven of them are subject to decisions made by leadership or administration in the process of implementing and encouraging the use of an LMS. Five of them are predictors of Perceived Usefulness (Job Relevance, Output Quality, Results Demonstrability) or Perceived Ease of Use (Perceptions of External Control, Perceived Enjoyment) and two of them are direct predictors of Behavioral Intention (Voluntariness and Change Fatigue).
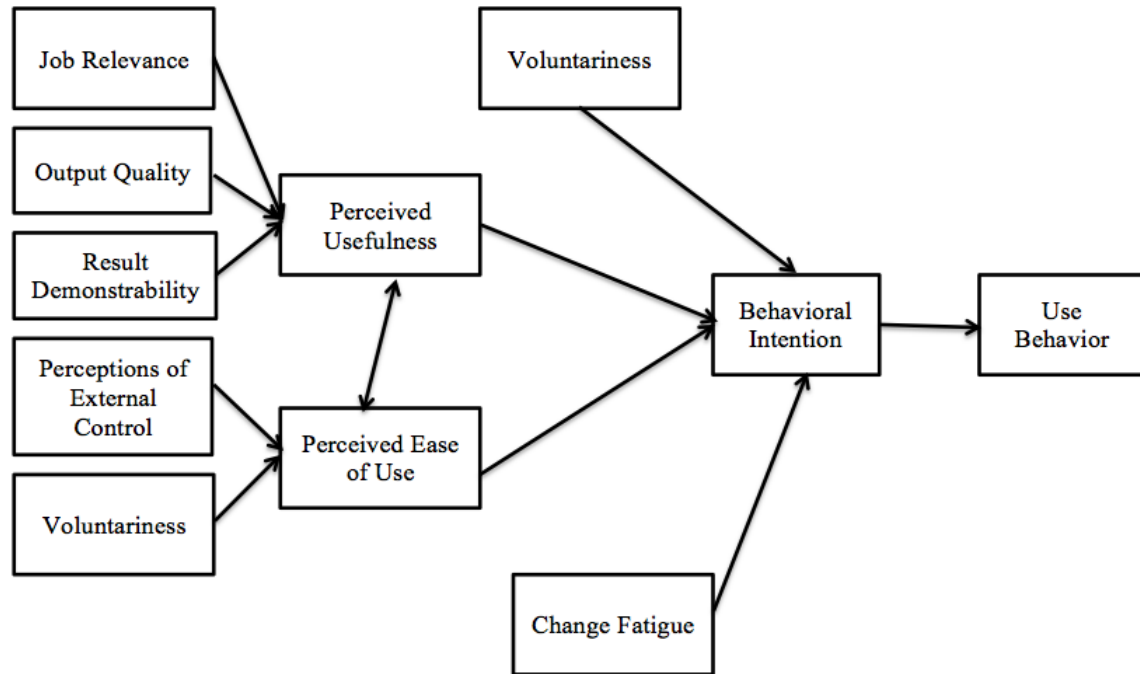
Figure 7. Proposed TAM Model

Only Voluntariness is under the direct control of leadership choices or policy.

Leadership choices or policy can *influence* the five predictors of Perceived Usefulness

and Perceived Ease of Use but there is no direct control. For instance, administration can,

by vote or decision, mandate that all faculty members use the provided LMS. They

cannot mandate that an LMS is job relevant, but they can select an LMS that best fits the

needs of the university and educate the faculty about its many useful features. Indiana

University grouped the many features of LMSs into seven categories, representative of

the broad constituent needs across the university: content creation, management, and

reuse, learning activities, teaching and learning management, user autonomy,

personalization, and self-management, social interaction and collaboration, openness,

licensing, and standards, and assessment, tracking and reporting (IU Committee, 2013).

However, while effective design choices and education may increase the perception of

job relevance among faculty, faculty still have the choice of deciding whether or not the technology is relevant to their jobs.

Change Fatigue is the one variable that can only be peripherally influenced by administrative choices or policies. It is not a perceptual issue. No amount of persuasion by a Vice-President or Provost can shift a person suffering from Change Fatigue to suddenly decide, "Oh, I guess I was wrong! I am not at all fatigued." However, as managers respond appropriately to a situation of high Change Fatigue, integrating all of the following interventions, the incidence of Change Fatigue may, over time, decrease among the faculty.

Venkatesh and Bala (2008) provide an excellent framework of the most effective procedures for ensuring maximum use and acceptance of an LMS. An adapted version of their table of interventions and determinants is found in Table 13. The structure of their framework is followed here as this important topic is considered.

First, Venkatesh and Bala (2008) point out that there are both "preimplementation" and "postimplementation" interventions that increase both use behavior and faculty acceptance of the LMS. The "preimplementation" factors include: Design Characteristics: This intervention is associated with selecting the LMS that most perfectly accomplishes tasks desired by and useful to faculty and students. Two types of design characteristics are considered: a) information-related. This aspect is associated with usefulness, that is, what information may be accessed using a particular LMS. For example, is it possible to get reports on student performance, or is it possible for students to access their grades? The second is b) system-related.

Table 13

Summary of Interventions

	Preimplementation Interventions				Postimplementation Interventions		
	Design Characteristics	User Participation	Management Support	Incentive Alignment	Training	Organizational Support	Peer Support
Determinants of Perceived Usefulness							
Job Relevance	X	X	X	X	X	X	X
Output Quality	X	X	X	X	X	X	X
Result Demonstrability	X	X	X	X	X	X	X
Determinants of Perceived Ease of Use							
Perceptions of External Control		X	X		X	X	X
Perceived Enjoyment	X	X		X	X		
Determinants of Behavioral Intention							
Voluntariness			X	X			
Change Fatigue	X	X	X			X	X

X indicates a particular intervention can potentially influence a particular determinant of Perceived Usefulness, Perceived Ease of Use, or Behavioral Intention

System-related factors are associated with ease of use—things that make it easy, enjoyable or efficient for faculty and students to use the system.

User Participation: The hands-on participation by the potential users in assessing and selecting the LMS used by the university, testing the LMS, customizing it to best fit the needs of the university, and preparing the university for implementation of the LMS.

Management support: The degree to which the faculty believes that administration has committed to successful implementation and use of a particular system.

Incentive alignment: Employees find that the system features and capabilities are aligned with their interests (facilitating their academic objectives), incentives (materially enhancing the ability to carry out their duties), and values (enhancing faculty ability to communicate their values through instruction).

The "post" factors include:

Training: Faculty are adequately trained to be able to use all important features of the LMS by whoever is best suited to accomplish this task.

Organizational support: This differs from Management support (above)—associated with administration support and commitment--and is focused on technical aspects of the LMS typically provided by the IT department of the university. This reflects an integration of those fluent in the technical aspects of the system with those who use it.

Peer support: This involves more experienced co-workers who are willing to assist when a faculty member runs into a difficulty using the LMS. It also includes formal or informal training where faculty of various levels of experience can mingle,

modification or enhancement of the system by IT personnel, or joint modification or enhancement through cooperative effort of faculty member(s) and IT personnel.

**Connections Between the Interventions and
the Seven Predictor Variables**

In the paragraphs that follow, each of the seven interventions are associated with the appropriate variables to identify the value and impact of applying each intervention, based on the findings of this study and the resulting model. Successful application of the interventions has the potential to improve the ways administration and faculty may implement and support an LMS.

Design Characteristics: Excellent design characteristics incorporate the inclusion of suitable features and an interface that is intuitive and easy to use. As such, the wise selection of a well-designed LMS that best fits the needs of the university and the choice of additional features that further enhance, has the power to influence all five of the predictors of Perceived Usefulness and Perceived Ease of Use. For instance Job Relevance, Output Quality, and Result Demonstrability all focus more on the actual features of the LMS. That is "What tasks can this LMS accomplish?" Perceptions of External Control and Perceived Enjoyment are more associated with an intuitive interface and ease of use.

These five variables are the direct predictors of two of the central four qualities in the model. Job Relevance, Output Quality, and Result Demonstrability are the direct and robust predictors of Perceived Usefulness. The best way for administration to influence the perception that a system is useful is by devoting their energies to selecting an effective system and encouraging a perception by faculty that the system is relevant, that the quality will be outstanding and that the beneficial results are clear to see.

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Perceptions of External Control and Perceived Enjoyment are the direct and robust predictors of Perceived Ease of Use. Once again, if administration is wise in selecting a well-designed system, faculty can rightly view the system as their servant to accomplish important purposes (that is, they have control over the system as opposed to constantly being at its mercy). Further, if the system is well designed and intuitive, faculty will experience greater enjoyment in its use. The best way for administration to enhance Perceived Ease of Use is to focus their attention on these two predictors.

User Participation: This topic addresses a thoroughly different aspect of adoption and implementation of an LMS. It addresses the reality that if the faculty are heavily involved in the selection, designing, testing and customization of an LMS, those involved in the process will be much more accepting of the selected system. Across the broad array of human accomplishment, when an individual takes ownership of the selection and implementation of any system or procedure, he has a vested interest in ensuring that it is successful (Petty & Cacioppo, 1990; Wagner, Parker, & Christiansen, 2003).

User participation is primarily associated with the five predictors of Perceived Usefulness and Perceived Ease of Use. Faculty members, in cooperation with administrators who are involved in the process, will make efforts to maximize the benefit of these five predictor variables. Because of their efforts they will be keenly aware of why one system is chosen over another and why additional features are selected. This can then be communicated with enthusiasm to other faculty members. This communication will have far greater impact than a command decision and announcement from administration that "This is the system we have selected. Use it!"

Management support: This intervention involves the responsibility of leadership to clearly communicate its commitment to and support of the chosen Learning Management System. Administrative support assures faculty that other necessary resources for success will be put in place: financial incentives, time off work for training, and appropriate pressure for successful implementation. Ensuring that senior administration, deans, chairs, and department heads are vocal and clear in their support as change champions will encourage higher levels of Perceived Usefulness and Perceived Ease of Use (Howell & Higgins, 1990; Venkatesh & Bala, 2008).

Job Relevance, Output Quality, and Result Demonstrability determine Perceived Usefulness. Management support facilitates participation in the system development and implementation processes, which is directly tied to these three variables. Strong input from faculty allows them to influence and shape the LMS that will likely be theirs to use for a long time.

University administration can encourage faculty perception of high Perceived Ease of Use and Perceptions of External Control. Administration commitment to providing the best possible system goes hand in hand with providing the external resources are available to make faculty feel that they are in control.

Incentive alignment: An often-asked question is "What's in it for me?" and university faculty, busy as they are, are evaluating where the best places are to put in their effort. Understanding the value of incentives in adoption and use of technological innovations is an important step for university leadership. Incentive alignment does not typically refer to financial incentives as much as to the experiential incentives faculty and those with whom they deal receive from using the LMS.

As such, important variables related to incentive alignment are Job Relevance, Output Quality, and Result Demonstrability. A relevant LMS enables faculty to, for instance, share desired information with students, complete the grading process, interact with students, and check for plagiarism. These are activities that are directly tied to the work responsibilities of a professor. Such a system benefits not only the professor, but also those who experience the outcomes of the system—especially the students whom the professor serves. High quality LMS output delivers desirable outcomes, and an LMS whose performance is obviously strong will have easily demonstrable results that will be well-aligned incentives. The alignment of incentives requires preparation and therefore must be considered a preimplementation intervention.

The three postimplementation interventions include training, organizational support, and peer support.

Training: This intervention has been alluded to in the area of management support. Training is a key intervention with any new innovation, and especially with technology-rich innovations. Training makes and reinforces connections between the technology and the duties of the faculty member, thus increasing Job Relevance. Training should occur several times, and as needed, to ensure that faculty with different levels of computer ability have enough opportunities to develop competence. Training clearly improves Output Quality and Result Demonstrability, as faculty members learn the features of the LMS. This enables faculty to get the most out of the LMS and trainers have the opportunity to make clear the benefits of the system so that faculty are able to explain them to others. Through these three variables, training supports Perceived Usefulness.

Training also influences Perceptions of External Control and Perceived Enjoyment, determinants of Perceived Ease of Use. Training is part of the external support of the organization and is designed specifically to ensure that faculty feel in control of the Learning Management System and can get the most out of their experience. Training is tied to enjoyment. Those who are best skilled at driving a vehicle, and least worried about being able to merge into highway traffic or make a left turn at a traffic light, are most able to enjoy the experience of driving. Likewise, those who are best trained in the use of the LMS will be most able to enjoy it, increasing Perceived Ease of Use.

Organizational Support: Once an LMS has been implemented, the need continues to exist for assistance and training. Whether in the form of an IT helpdesk staffed with helpful, eager support of individuals ready to assist early in the implementation phases, or having faculty attending annual conferences put on by the designer of the LMS, formal and informal forms of support continue to develop the faculty members' abilities to use the LMS, especially as new features are introduced with upgrades and new releases. External consultants in the form of business process experts assist faculty in rearranging their workflow to be more compatible with the benefits and limitations of the LMS.

Organizational support, particularly in the forms of training it provides, continues to enhance Job Relevance. To those who have attended conferences put on by LMS creators, the experience of being introduced to new features by the very enthusiastic designers who brought those features into existence is inspiring. Having an IT helpdesk available to assist faculty in getting the most out of the LMS is a clear way to ensure high quality output. Output Quality supports Perceived Usefulness, as does Result

Demonstrability. The work of business process experts helps faculty to redesign their work and clearly demonstrate how the LMS benefits the work.

Organizational support also enhances Perceptions of External Control, as faculty have a sense through the infrastructure and supports that organizations can provide that they are in control of the technology. Organizational support therefore supports both Perceived Usefulness and Perceived Ease of Use.

Peer Support: Peer support involves the activities that coworkers perform that help a faculty member to effectively use an LMS. Often faculty would rather ask one another for help than call upon the formal resources that the university makes available. Peer support interventions are able to influence the same determinants as organizational support: Job Relevance, Output Quality, Result Demonstrability, and Perceptions of External Control. Others who have used and are familiar with LMSs can quickly share the qualities that make it relevant to the job, share tips for increasing the quality, and communicate the elements of the results that they have experienced, showing other faculty how to achieve similar results. Perceptions of External Control are enhanced as they feel in control of their LMS use through the support of their peers. Thus, peer support also encourages both Perceived Usefulness and Perceived Ease of Use.

Change Fatigue

Change Fatigue differs from the other variables in that it cannot be directly influenced by administration interventions. It represents the sense of malaise felt by faculty from repeated change. While administration cannot directly influence Change Fatigue, decisions can be made that provide an environment that helps faculty deal with the effects of Change Fatigue, and be willing to use an LMS despite the frustration and

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cynicism that many changes can bring. Such an environment is one where, as much as possible, faculty feel in control of what is happening, feel that they have a voice, have a change calendar to be aware of the change timeline, where trust is high, teams are strong and supportive, and where two-way communication is present (LaVelle, Lavelle, & Valusek, 2011; Mayer & Hammelef, 2013). All of the Venkatesh interventions, used wisely by administration, have the ability to produce that environment for faculty as they realize that the well-designed system over which they have had participative influence will be different than the experiences they may have had in the past with Learning Management Systems or other technological change. The support from the leadership, organization, and peers all reduce frustration that may have been felt in the past with technology. Effective training and clear alignment of incentives support and encourage faculty as they reconsider their attitude toward the software.

Appreciate that change fatigue has typically developed over a numbers of years and reduction of change fatigue may be a long and gradual process. However, with consistent adherence by faculty and staff to wise selection choices, administrative and IT support, involvement of faculty in selection and modification of the LMS, and other recommended interventions, the incidence and severity of Change Fatigue can be reduced over time.

Voluntariness

Voluntariness is the only one of the seven predictor variables over which administration has direct control. University personnel may mandate that all faculty members use an LMS, and, present results suggest that such a requirement has a substantial positive influence on actual usage. However, as dichotomous as the concept of

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"mandating usage" may be, as a variable it is surprisingly continuous. In fact, the actual distribution rates in the "excellent" range for skewness and kurtosis as normally distributed. This suggests that while administration at a particular university may mandate use of an LMS, faculty do not seem to view this as black and white. The variability of reaction is typically due to whether adherence or not has consequences.

For instance, one faculty member may say, "I have excellent resources that accomplish the same purpose as the LMS and would prefer to use them." If administration's response is "That seems fine," this encourages the perception that the requirement is not so absolute. On the other extreme, if administration docked pay for those who did not use the LMS, it is likely that everyone would use the LMS or change employment. However, history has demonstrated that an arbitrary, unpopular, decision may cause reactance (Brehm, 1966), that is, participants actually rebelling against use of the system.

An answer may seem to lie in an administrative decision that is supported by the faculty. For instance, if administration did an excellent job of selecting the best system, involving faculty in the process, demonstrating clear management support of the decision, organizing the LMS so that benefits were experienced by faculty, allowing faculty to have the best support, ensuring powerful organizational support, and creating structure for faculty to support one another, it is likely that an informed requirement might produce the best results.

Ways to Improve Future Studies and a Final Word

Every study has weaknesses. Viewing these weaknesses proactively might be rendered, "Every study provides opportunity for future improvements." The present study is not exempt.

One prominent weakness is the operational definition of Experience. In the present study Experience is operationalized as "the total number of years teaching at the university level." While this variable provides some interesting and useful correlates with other variables, future studies need to recreate Experience as actual usage of the Learning Management System. This requires thorough effort to craft a variable that adequately assesses Experience with the present or prior LMSs.

Another weakness is in the measure of Perceptions of External Control. In the present study this variable is operationalized as "I am confident in my ability to control the [LMS]." Ideally this might be broken down into several questions that capture the nuance of this variable. For instance questions might assess "my training has helped me use the LMS," or "I know I can rely upon the Help desk to resolve my LMS challenges," or "I am confident that the LMS can accomplish desired tasks," or a reverse-coded question, "the current LMS is not compatible with other systems that I use."

A third issue is the measure of Objective Usability. In the present study it is operationalized as the amount of time to complete a simple task using the LMS of their university. The challenge of this type of measure is that the researcher must consider how much time and effort are participants willing to endure. Even this one simple task defeated several of the participants in the present study who simply did not complete it. For future studies it remains a serious problem. A financial incentive seems ineffective.

In the present study, a trivial $10 incentive would cost $2000 and probably not increase

participation significantly. A financial incentive that a potential participant might actually

notice would present a crushing financial burden without grant sponsorship.

Finally, an objective assessment of how much each faculty member actually used

the LMS proved to be quite impossible. Obviously it would be desirable to have objective

data to back the perceptual data used in the present study. To acquire equivalent data

from the nine different universities using four different Learning Management Systems

proves to be unattainable.

Directions for Future Study

The findings of this study are valuable and useful, and this dissertation serves as a

stepping off point for future research and inquiry. Several areas come to mind when

considering future research directions.

1. The role of satisfaction can be examined to determine if a causal relationship

exists between it and behavioral intention or use behavior. All four of the central

variables in the TAM 3 model were positively and significantly correlated with

satisfaction and it would be valuable to know the directions of any causal arrows.

2. Further study could be done into the strength of the Learning Management

System on the determinants of Use Behavior. This study found that *Canvas* enjoyed a

sizable advantage over the others. While factors other than use behavior play into

university adoption decisions, this information would be valuable to decision makers.

3. This study was focused on Seventh-day Adventist university faculty. It would

be interesting to see if the results would be replicated in global Adventist, other faith-

based, and in public universities.

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4. This exploration could be combined with rigorous testing of the new simpler model to see if it carries strong predictive weight as a model.

5. Structural Equation Modeling (SEM) is an approach sometimes used to identify and test models. Further research could be done using SEM to test and evaluate the relationships identified in this study.

6. Finally, the Venkatesh interventions could be identified in the field and efforts could be made to correlate implementation of the interventions with the degree of adoption success at universities and colleges.

Research is not a terminal experience, but one that continues, building upon the findings of the past and moving toward a future of greater knowledge and application. It is hoped that this researcher and others may take up the challenge to discover more in these areas.

Summary

Learning Management Systems have become a critical element of Adventist higher education. Understanding faculty response is particularly helpful when an organization is selecting a new LMS, changing to a different LMS, or upgrading an LMS to a significantly different feature set. Understanding interventions that increase the usage behavior of faculty members is a benefit for universities and their decision makers.

In this study, faculty members from nine different Seventh-day Adventist universities were surveyed, assessing the various elements of Venkatesh and Bala's (2008) Technology Acceptance Model 3. Two additional variables were proposed as having significant influence in the model. Several variables are found to be non-significant: Subjective Norm, Image, Experience, Overload, Computer Anxiety,

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Computer Playfulness, and Objective Usability. The resulting, more parsimonious model maintains with core elements of the TAM 3 along with the determinants Job Relevance, Output Quality, Result Demonstrability, Voluntariness, Change Fatigue, Perceptions of External Control, and Perceived Enjoyment. It provides a robust and effective model for predicting Behavioral Intention and Use Behavior, suggesting that administrators pay close attention to Perceived Usefulness, Perceived Ease of Use, Voluntariness, and Change Fatigue in selecting and implementing any new system or in increasing adoption of the current LMS.

Administrators are encouraged to implement interventions that directly influence the relevant and significant model components, which are expanded upon in this paper. Through effective decisions, faculty will experience Learning Management Systems that meet their needs and the needs of the students with whom they work.

APPENDIX A

SURVEY INSTRUMENT

The survey was administered using the online survey tool SurveyMonkey. Each of the nine universities had a custom set of questions and a separate collector. The following is a representative list of questions for Pacific Union College:

Andrews University
Leadership
Informed Consent Form

The activity involves research using the online survey program SurveyMonkey. The research involves surveying of randomly selected Adventist faculty members from among the North American universities and colleges. The purpose of the research is to understand how you as a faculty member respond to changes in the Learning Management Systems that exist on your campus. The survey should take between 20 and 30 minutes.

Administrators, in particular, will benefit from understanding the impact of changes on faculty, and the appropriate steps to take when changing a Learning Management System to ensure a successful transition. Participating faculty will find the results insightful as they cast light upon how you and your colleagues are impacted by changes in technology. There are no therapeutic procedures involved.

While the questions involved are not perceived to be sensitive, the confidentiality of respondents will be maintained limiting access to data to the researcher and his methodologist. Any communications will be aggregated. The researcher will not know what responses come from which individual respondents.

If you have any questions about the research, your rights, or related matters, please contact me, David Jeffrey, at Canadian University College, 5415 College Avenue, Lacombe, Alberta, Canada, T4L 1C7, or by phone at 403-598-6287.

Participation is completely voluntary, and refusal to participate involves no penalty or loss of benefit to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss to which you are otherwise entitled had you completed your participation in the research.

Signed,

David Jeffrey

Your implied consent is recognized by your completion of this survey.

The 7-point Likert scale used with ALL but two of the questions were: 1 (*strongly disagree*), 2 (*moderately disagree*), 3 (*somewhat disagree*), 4 (*neutral*), 5 (*somewhat agree*), 6 (*moderately agree*), and 7 (*strongly agree*).

1. I use *Canvas* to integrate sharing of content and/or class documents into my class.

2. I use *Canvas* to integrate the use of the calendar function into my class instruction and course management.

3. I use *Canvas* to integrate the use of the grade book into my class instruction and course management.

4. I use *Canvas* to integrate the use of the quiz tool into my class instruction and course management.

5. I use *Canvas* to integrate the use of the test administration function into my class instruction and course management.

6. I use *Canvas* to integrate the use of message boards into my class instruction and course management.

7. I use *Canvas* to integrate the use of announcements into my class instruction and course management.

8. I use *Canvas* to integrate the use of the dropbox/assignment area into my class instruction and course management.

9. Perceived usefulness 1. Using *Canvas* at Pacific Union College increases my job-related productivity and effectiveness.

10. Perceived usefulness 2. Using *Canvas* at Pacific Union College increases my job-related effectiveness.

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11. Perceived ease of use. I find *Canvas* at Pacific Union College clear and understandable.

12. Computer Self-Efficacy. I am fluent in the use of a computer.

13. Computer Self-Efficacy 2. I can figure out almost any software program with a minimum of effort.

14. Perceptions of External Control. I am confident in my ability to control *Canvas*.

15. Computer Playfulness. I like to be creative and have fun when using computers.

16. Computer Anxiety. I get dysfunctionally nervous when working with a computer.

17. Perceived Enjoyment. I enjoy myself when using *Canvas*.

18. Objective Usability: Task: Open your LMS. From the main screen of any course, time how long it takes for you to create a news/announcement item with the title "Test Announcement" and the text "Technology is fun!" Responses: 1. 0 - 9 seconds, 2. 10-19 seconds, 3. 20-29 seconds, 4. 30-39 seconds, 5. 40-49 seconds, 6. 50-59 seconds, 7. 1 minute or more.

19. Subjective Norm 1: My colleagues think I should use *Canvas*

20. Subjective Norm 2: The administration urges us to use *Canvas*

21. Voluntariness 1: It is my choice whether I use *Canvas* at Pacific Union College.

22. Voluntariness 2: I am given the freedom to choose whether or not I use *Canvas* at Pacific Union College.

23. Image: Administrations and colleagues at Pacific Union College will think highly of me if I use *Canvas*.

24. Job Relevance: The use of *Canvas* is pertinent to my job-related tasks.

25. Output Quality: I consider the output of *Canvas* to be excellent.

26. Result Demonstrability: I believe I would have no problem explaining to someone else the benefits of using the various features of *Canvas*.

27. Behavioral Intention: I intend to make good use of *Canvas* Pacific Union College has provided.

28. Change Fatigue 1: The people at Pacific Union College who are responsible for solving problems don't try hard enough to solve them.

29. Change Fatigue 2: I am tired of all of the changes in Learning Management Systems at Pacific Union College.

30. Overload 1: I feel burdened with too many tasks and responsibilities at Pacific Union College.

31. Overload 2: I often feel exhausted and/or that my efforts are useless because of my work at Pacific Union College.

32. Use 1: On average, how much time do you spend on *Canvas* each day? 1. (*none*), 2 (*1-5 min), 3 (6-15 min*), 4 (*16-30 min*), 5 (*31-59 min*), 6 (*1-2 hours*), 7 (*> 2 hours)*

33. Use 2: Does an assistant use *Canvas* on your behalf? The original Likert scale is used for the final three questions.

34. Present Satisfaction: I am satisfied with the present LMS at Pacific Union College.

35. Future Desire: I would welcome a different LMS at Pacific Union College.

Demographic Questions

36. What is your gender? (male, female)

37. What is your ethnicity (White, Black/African-American, Hispanic/Latino, Native American/Alaskan, Native Hawaiian/Pacific Islander, Mixed Race/Other)

38. In what year did you begin serving at your current university? (value input)

39. What is the total number of years you have been teaching at any university? (value input)

40. At what university did you receive your highest degree?

APPENDIX B

Letters of Permission
(actual letters removed)

Institution	Date	Approval
Andrews University	October 27, 2014	Andrea Luxton, Provost
Andrews University (IRB)	January 15, 2015	Mordekai Ongo, Research Integrity & Compliance Officer
Burman University (IRB)	November 25, 2014	Joy A. Fehr, Vice-President, Academic Administration
La Sierra University (IRB)	October 27, 2014	Leslie R. Martin, Interim Chair
Loma Linda University (IRB)	January 9, 2015	Linda G. Halstead, Director of Research Protection Programs
Loma Linda University (Religion)	February 1, 2015	Jon Paulien, Dean
Loma Linda University (Nursing)	January 20, 2015	Elizabeth Bossert, Dean
Loma Linda University (Allied Health Professions)	January 20, 2015	Craig Jackson, Dean
Loma Linda University (Dentistry)	January 20, 2015	Ron Dailey, Dean
Loma Linda University (Pharmacy)	January 19, 2015	Billy Hughes, Dean
Pacific Union College (IRB)	September 23, 2014	Ed Moore, Associate Academic Dean
Southern Adventist University (IRB)	January 14, 2015	Cynthia Gettys, Chair
Southern Adventist University	November 10, 2014	Robert Young, Senior Vice-President for Academic Affairs
Southwestern Adventist University (IRB)	November 10, 2014	Marcel Sargeant, Chair
Union College (HSRB)	November 6, 2014	Trudy Holmes-Caines, Chair
Washington Adventist University	November 24, 2014	Cheryl H. Kisunzu

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Assistant Professor	Burman University	2005 – Pres.	Business
Teacher	Crawford Adv. Acad.	2000 – 2005	Business
Assistant Professor	University of the Southern Caribbean	1997 – 1999	Bus./Econ.
Instructor	USC	1995 – 1997	Bus./Econ.

ADMINISTRATION APPOINTMENTS

Appointment level	Institution	Dates
Chair, School of Business	Burman University	2010 – Present
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SCHOLARY PARTICIPATION

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Non-refereed Publications

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Presentations

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